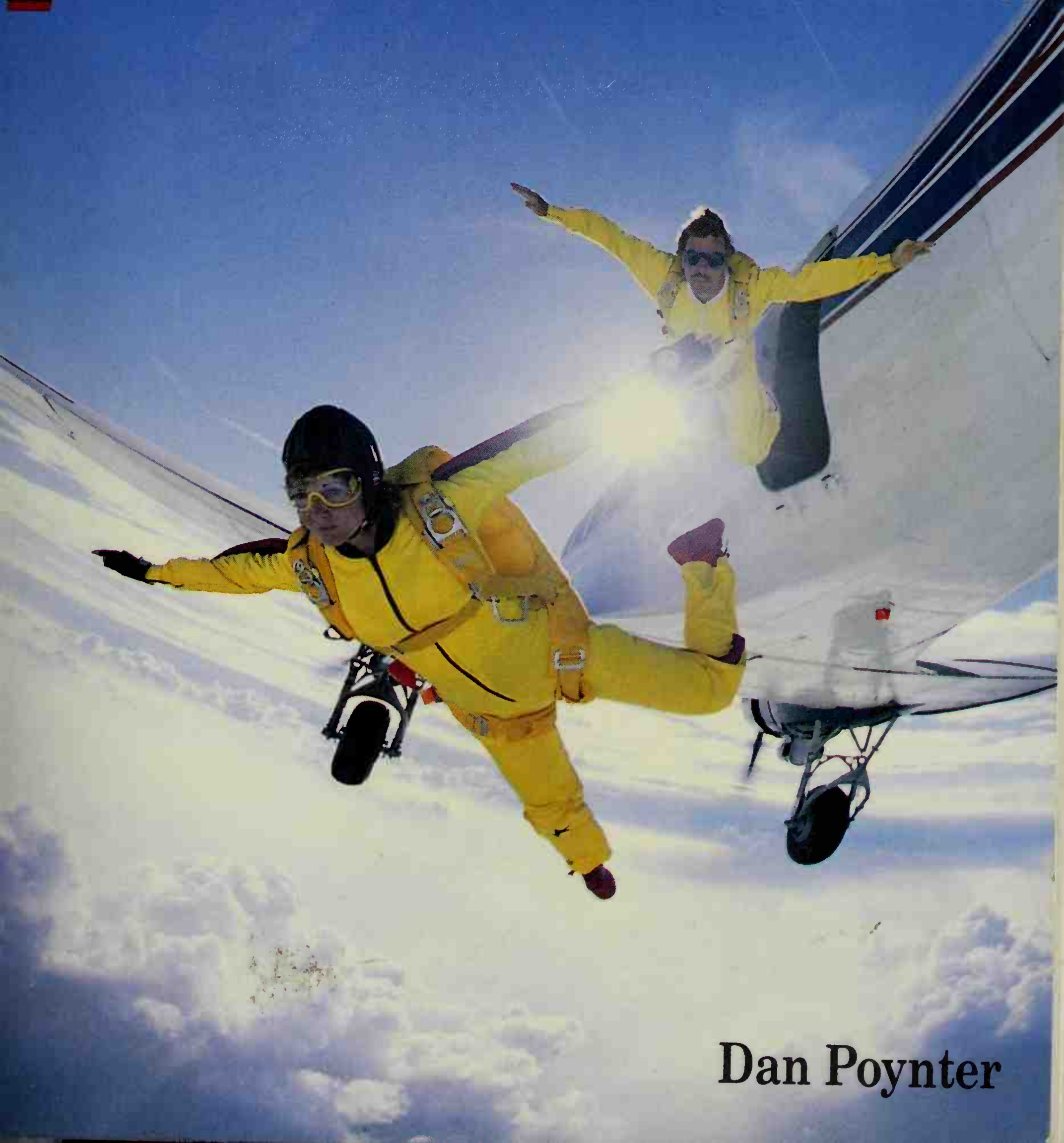
Fifth Edition
Completely Revised

PARACHUTING
THE SKYDIVER'S HANDBOOK



Dan Poynter

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Fifth Revised Edition

Para Publishing, Santa Barbara, California

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by Dan Poynter

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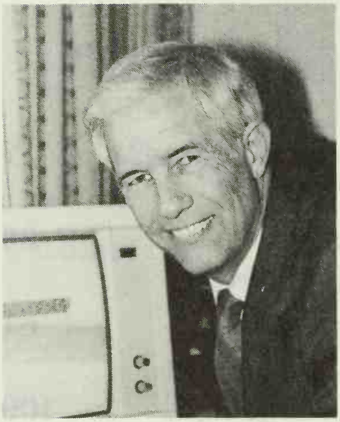
About the Author



Dan Poynter is an expert parachutist with all the highest licenses and ratings, a licensed pilot, and a certificated master parachute rigger, who began his aviation career in 1962 when he made his first jump while attending law school. During his 1,200 jump career he has been responsible for numerous notable equipment advances (some patented) and, perhaps even more important, the dissemination of an incredible amount of parachuting information.

Dan served as a member of the United States Parachute Association Board of Directors from 1966 to 1978, and has served as Chair of the Safety and Training Committee where he helped develop USPA's Jumpmaster and Instructor programs; as a member of the Executive Committee; as Secretary, and as Chairman of the Board. He served as Equipment Inspector at the U.S. National Parachuting Championships for ten straight years while often also taking part as a competitor, training judge or President of the Jury. In 1969 he established a parachute rigging school which became world famous. He has been an Instructor/Examiner since 1964.

Gliding canopies led Dan to rigid gliding devices and into hang gliding; he's written four books on the subject. Appointed Flight Examiner by the U.S. Hang Gliding Association, he served on the Board of Directors. In 1977, after two terms as President, he was elected President d'Honneur of the Commission Internationale de Vol Libre (Hang Gliding) of the Federation Aeronautique Internationale, the world body which governs aviation competition and records. He also served as U.S. alternate delegate to the Commission International De Parachutisme.

Dan was the founder and ten-year editor of the *Spotter*, parachuting's newsmagazine; his articles have been published in numerous periodicals in both the U.S. and abroad, and he is probably best known for his *Parachutist* magazine column, titled *Parachuting Poynters*, which has appeared since 1963.

Dan is one of sport parachuting's most energetic, experienced and respected leaders.

Introduction

This book is written around the newer equipment that is making our sport even more exciting: square ram-air canopies and piggyback container systems. Student equipment and training techniques are undergoing a transition so the descriptions here may not be precisely what you will see at your nearest drop zone. Ask your instructor for an explanation or clarification. See the Glossary in the back of this book for words that are not familiar to you.

Check the Appendix of this book for the drop zone, club, school, commercial center or equipment dealer nearest you. Then call or visit for more information.

Acknowledgment

This book is a group effort. Many thanks for the advice received from Jeff Jones and Steve Mack of Perris Valley Paracenter, pilot Bob Jones, Tony Dell, and Dan Tarasievich. Drawings came from Para-Flite, Inc. and George Galloway of Precision Aerodynamics. Peer reviewers who checked chapters in which they have a special expertise were Kevin Gibson, Editor of *Parachutist* Magazine; Mike Johnston; Paul Sitter; Doc Maglaughlin; Rob Laidlaw, Chairman for the Coaching Working Committee in Canada; Jan Meyer, Editor of the *Sport Parachutist's Safety Journal*; Bill Dause; Paul Fayard; Jim Mowrey; Bill Gargano, and Sandy Reid. Photographs were supplied by Robert Tomany, Bill Lamping, Richard "Jake" Jacobson, Douglas Feick, Andy Keech, Jeff Kovin, Mike McGowan and Norman Kent. And many thanks to Kathy Peters for her copy editing and to Paul Fraser for his illustrations.

I sincerely thank all these fine people and I know they are proud of the part they have played in the development of the parachute, the training and the sport, as well as of their contribution to this work.

Cover photo by Tom Sanders, Aerial Focus

Warning-Disclaimer

Whenever a person leaves the ground, he or she risks injury or even death. Whether to accept or reject this risk and its accompanying challenge must be a personal decision; one must weigh the risk and the reward. This book is designed to promote safety through education.

This is not a do-it-yourself text. The information contained here is intended as an introduction to the sport and as a source of reference. After reading this book, visit one or more of the firms listed herein for further information and instruction.

This book is designed to provide accurate and authoritative information in regard to the subject matter covered. It is not the purpose of this manual to reprint all the information that is otherwise available, but to complement, amplify and supplement other courses and texts. For more information, see the many references in the Appendix.

The purpose of this manual is to educate and entertain. Every effort has been made to make this book as complete and as accurate as possible. However, there may be mistakes both typographical and in content. Therefore, this text should be used only as a general guide and not as the ultimate source of skydiving information. Furthermore, this manual contains information only up to the printing date.

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Your parachuting instructor will be happy to explain any area of this book that is not clear to you.

Chapter One

Jump? Out of an Airplane?

Sport parachuting is fun! Skydiving is not just falling, it is flying—the closest we have been able to come to free, unencumbered, non-mechanical individual flight. Nearly everyone flies in their dreams; the young idolize Superman while the old admire the birds. Anyone who has sprung from the three meter board, jumped from the hayloft into a haystack or even stood on a hill in a high wind with arms outstretched has experienced a form of non-mechanical flight. Skydiving, individual and group human flight, is what this book is all about.

See the equipment chapter and the Glossary in the back of this book for any words that are new to you.

> If riding in an airplane is *flying*, then riding in a boat is *swimming*. If you want to experience the element, get out of the vehicle.

Since parachuting began to catch on as a sport in the late fifties, it has become a well organized, widely recognized form of aviation activity and is now an established recreational pursuit. Just as airline travel has changed dramatically since its beginnings back in the early 1900s, advances in techniques and equipment have made the sport of skydiving relatively safe and thoroughly fun.

Equipment. Sport jumpers wear a highly maneuverable *main* parachute that lets them down so softly they can easily stand up on landing. They wear protective clothing: a helmet, a jumpsuit, and perhaps goggles and gloves. And they wear an extra *reserve* parachute for the same reason you use a seat belt in your car—for protection in that rare case when something goes wrong.

Going up. After you suit up, you climb aboard the aircraft with fellow parachutists for a ride thousands of feet above the ground. The higher you go, the longer your freefall. A common freefall time is 30 seconds, starting from 7,500 feet or 2,300 meters. Once the aircraft reaches the planned jump altitude, the jumpmaster directs the pilot to fly the plane over the proper point on the ground so that even with some wind, you will land on target. Then out you go!

Skydiving. After leaving a perfectly good airplane, you will accelerate for eleven seconds until you reach some 110 mph and *terminal velocity*, that speed at which your weight equals your wind resistance. You will continue to fall at this same speed unless you alter your body position; we will explain why later.

Does it feel as if you are falling? No—it's more like flying. Although you reach 110 or even 190 miles per hour in a dive, you merely feel the pressure of the air against your body. It is a simple matter to use that air pressure to perform loops and rolls and even to *track* across the ground. Experienced jumpers frequently exit the airplane with fellow jumpers and, by maneuvering their bodies, join up to form countless formations; and they still have time to move away from each other to open their parachutes in uncrowded sky.

After checking your altimeter, you end your freefall by deploying your parachute at 2,500 feet (750 m). A rustle of nylon and a tug at the shoulders—and then there is an astounding silence as you hang beneath a multi-colored nylon wing for the three to four minute flight to the landing area.

The canopy ride. When you deploy your parachute, you suddenly increase the ten square feet of air resistance to your body to approximately 250 square feet of drag provided by a nylon canopy measuring some 11 x 23 feet. This wing-like soft nylon structure descends at a gentle ten feet per second and may be flared for a tip-toe landing. The ground below is a panorama of color, the air smells fresh and there is wind in your face.

Landings are like hopping off a cable car or, if you are not from San Francisco, like jumping off the rear bumper of a truck moving slowly at 3 to 5 mph. It's not hard, but tricky because of the horizontal movement produced by the wind and the forward motion of the canopy. As you gain experience, your landings will become softer and more precise. By flaring your canopy at just the right moment, you

will land just like a bird on a branch. Parachuting isn't as rough and tumble as its Army Airborne heritage would lead you to believe.

It must be remembered that the combat-scarred airborne trooper jumping into battle is using the parachute only as transportation; for him it is the fastest, safest and simplest way down. His physical conditioning prepares him for the mission which begins after the jump. Sport parachuting is considerably easier; anyone in reasonably good physical condition may participate.

⚠WARNING⚠

Parachuting is a high risk activity which may cause or result in serious injury or death.

The dangers. Without adequate initial training, proper equipment, and safe jumping procedures, the sport could be dangerous, and during its early phases, it WAS dangerous. But just as flying has been made safer, new and modern equipment, improved techniques and close supervision have eliminated every major cause of danger to the sport parachutist.

. . . And once you have tasted flight, you will walk the earth with your eyes turned skyward, for there you have been, and there you long to return. . .

Over 110,000 people make more than two million jumps each year in North America alone, with very few serious injuries. Twenty thousand active skydivers are making 100 to 125 jumps each year while some 90,000 students graduate from the *First Jump Course* (FJC). Like other action sports, parachuting is not without its *routine* minor injuries. However, the majority of injuries among skydivers are incurred when deviating from accepted safe jumping practices. Injuries, both fatal and non-fatal, do occur and this is why we have devoted a complete chapter in this book to the subject of parachuting emergencies.

Safety and Training Advisors. There are nearly 350 parachute centers across North America and jumping everywhere is under the control of about 375 Safety and Training Advisors appointed by the national organizations. Jumpmasters and instructors are certified by the U.S. Parachute Association in the United States and the Canadian Sport Parachuting Association in Canada, after undergoing rigorous training and testing sessions.

Parachute riggers. Experienced parachutists may pack their own main parachutes and you will pack your own main, under supervision until you learn how. Main parachutes to be used by others and all reserve parachutes must be packed only by federally licensed parachute riggers.

I'm a coward. And I'm the first one to admit it. It scares me. Everytime . . . it scares me. But I think we like to be scared. Good and Scared . . . and come out of it.

Competition. Parachutists have been competing for over 60 years—since, in fact, the Cleveland Air Races in the 1920s. Today, competitions range in size and scope from local fun meets, or *boogies*, to regional meets, and from the National Parachuting Championships to the World Parachuting Championships with over 30 participating countries. The sport is also popular at the collegiate level, where the National Collegiate Parachuting Committee, an affiliate of the USPA, sanctions local meets and conducts an annual championship meet that draws competitors from over 25 colleges and universities across the nation.

Not everyone competes because, as in other sports, many participants enjoy the sport without the pressures of competition.

Who skydives? You are probably not much different from the thousands of other newcomers to the sport who find parachuting a terrific new adventure and a lot of fun! Today's weekend sport parachuting enthusiasts come from almost every station in life. According to USPA figures, 17.9% of the skydivers are in top or middle management, 7.5% have supervisory positions, 19.5% are professionals, 13.3% are in the military, 16.5% are skilled labor, 6.6% are students and 18.7% fall into the miscellaneous column. Since skydiving is not inexpensive, it tends to attract those who can afford it. While 66% of all Americans have a high school diploma, over 90% of the sport parachutists do. Similarly, while 16% of the U.S. population has finished college, 40% of the skydivers have. In fact, over 20% of all jumpers have attended graduate school.

The median age for skydivers in the U.S. is 31 years while for the total population it is 30. But while 60% of the eligible U.S. population is married, only 39% of all skydivers are.

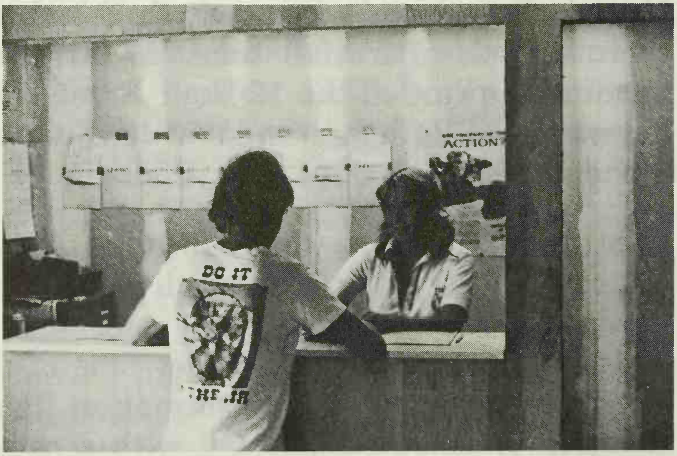
They all come out on the weekend to share a great common experience. There is no one classification, not even in physical condition. There are jumpers with one leg and some with no legs, with one eye and, yes, even blind. They start at 16 years, the minimum age, and go through their 80s. Some have prior military jump experience and more than 12% are female.

Since sport parachuting began to grow thirty years ago, skydivers have racked up a lot of experience and some interesting statistics. In the U.S. almost 3,000 have been awarded their Gold Wings for completing 1,000 jumps, more than 800 have over 2,000 jumps and 100 have crossed the 4,000 jump mark. Almost 12,000 have qualified for the USPA Class D Master Parachutist License. Jumpers also record their seconds of freefall time. So far, almost 1,700 have been awarded the 12-Hour Freefall Badge, 500 have crossed 24 hours and 150 have even managed 36 hours, for 1 1/2 days of skydiving!

But there is more to do besides just collecting jumps. Ten percent of the skydivers in the U.S. are hard core competitors in one or more of the individual or team events. While some of the rest instruct students, engage in formation flying Canopy Relative Work (CRW), or fall with a camera, most pursue relative work—formation skydiving with large or small teams. In fact, about half of all skydivers in the U.S. have participated in formations of 16 or more flying bodies.

Where? Sport parachutists often band together into small clubs for both economic and operational reasons. Also, because of the rapid expansion of the sport, many permanent commercial sport parachuting centers, similar to ski centers, have been established to cater to public parachuting needs. Most of these 350 groups may be found at small airports around North America.

To contact your nearest sport parachuting operation, consult the *Yellow Pages* under *parachutes* or *skydiving instruction* and/or call the nearest Federal Aviation Administration Facility. Look under *U.S. Government, Transportation, Department of*. Or you may write to the national organization for a directory (see the Appendix). If you live in a metropolitan area, there are probably a couple of jump operations within easy driving distance. They won't be in the middle of town because there isn't any room to land an airplane there.



Signing up

Parachuting is an adventure . . . A rousing adventure which is as thrilling and challenging and rewarding as any sport yet known to any age - Russ Gunby

Signing up. Upon arriving at the jump center, you will register with the school. The registration form will ask for your name, address, age, weight, occupation, and the name, address, telephone number of someone to contact in case of emergency. You will also be asked to sign a *waiver* or legal release. The release verifies that you understand there is an element of risk in skydiving and that you freely agree to accept that risk for yourself. There was a time when judges looked skeptically at recreation-facility waivers. They questioned whether people really understood they were signing away their right to sue, or even thought about the hazards. Today, there is a trend toward accepting signed legal releases. These cases never even reach the trial stage.

Age. To make static line or freefall jumps, you must have reached the *age of legal majority* (18 or 21 years old depending upon the law in your state or province), or at least 16 with notarized parental or guardian consent. If you are under 21, call ahead to the jump school and request a form be mailed to you.

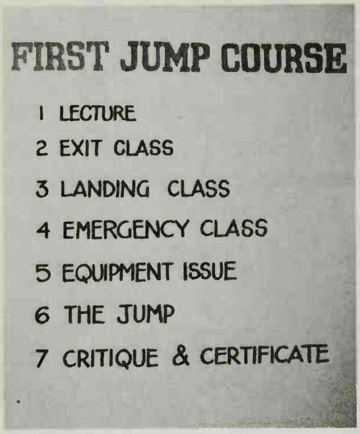
Medical. The forms also include a medical statement to alert you to the importance of being in good physical condition and not on any medication. The form will ask if you have been treated for, or diagnosed as having, any cardiac or pulmonary conditions or diseases, diabetes, fainting spells or convulsions, nervous disorders, kidney or related diseases, high or low blood pressure or any disability which might affect your ability to participate in skydiving. These and other problems will not necessarily eliminate you from parachuting; some conditions can be properly managed if the instructor knows about

them. If you are over 50 years of age, you must show an adequate level of strength and agility. Skydiving is not a strenuous activity but poor physical shape or being overweight can increase the potential for injury. You should avoid skydiving or flying for at least 24 hours after SCUBA diving.

Training. Students undergo a thorough half-day training session to acquaint them with the equipment, the exit procedure, canopy steering, landings, and emergency procedures. Some of the training is indoors in a classroom, and some is outside with various pieces of training equipment. The instruction, equipment rental (which includes its packing), airplane ride, jumpmaster fees, etc., are all included in the price of the first jump course.

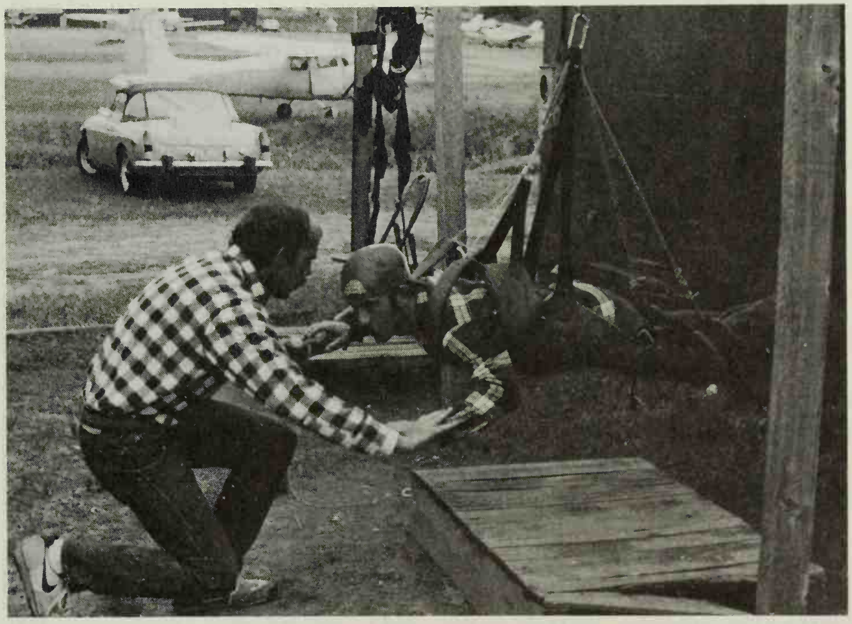
Classroom training

Apparently man has a need to have that hollow elevator feeling in his stomach when he straps on a helmet - Mike Truffer



Course overview

Exit training



Horizontal trainer

Now judges are coming to believe that individuals generally should be bound by what they sign. - The Wall Street Journal

Canopy steering

Breakaway training

Parachute landing falls from a one meter platform

Initial jumps. Today you have a choice as to how you wish to progress in parachuting. Each choice will provide you with certain basic skills.

Static line jump

—**Static line.** The traditional system of first jump instruction is the static-line method. This is a solo jump from 2,800 feet where as you fall away, the static line, which is attached to the aircraft, opens the main container and aids the deployment of the main parachute canopy. Once your canopy opens, you fly it to the landing area. The first jump course is typically four hours but may vary depending on the size of the class, type of equipment and your learning rate.

Some drop zones use a variation called *Instructor Assisted Deployment*. With the IAD system, the instructor holds the pilot chute in the airstream as the student exits. While the static line is eliminated, the principle is the same. Therefore, we will refer to static-line deployment throughout this text.

The first five jumps (minimum) are with a static line which activates the parachute automatically. From there you go to short delays, and progress to longer ones from higher and higher altitudes. After a *clear and pull*, you will make two 10 second freefalls from 4,000 feet, two 15 second skydives

from 5,000 feet, two 30 second delays from 7,500 feet, and three 45 second jumps from 9,500 feet.

The first jump will cost about $150.00. Your second static-line jump will run about $85.00 if you make it the same day, and many students do. Many drop zones also offer a block of jumps in a package at an attractive price. Once you have about 15 jumps, do not require a jumpmaster and purchase your own gear, jumps may run $10.00 to $15.00 each.

AFF jump

—**Accelerated Freefall**. AFF jumps start at 9,000 feet or more for a freefall of at least 30 seconds. Two certified instructors, one on each side, are with you during exit and freefall. At 4,000 feet, you deploy your main canopy and your instructors fall away, leaving you to fly your canopy to the landing area. Accelerated Freefall requires different training, an automatic release on the reserve parachute and two AFF-rated instructors during the jump. AFF is called *Progressive Freefall* in Canada.

Accelerated freefall training gets the student into the action sooner. This elimination of the static line and low jumps allows the student to progress much faster and to begin enjoying the freedoms of freefall flight much earlier.

The cost for the first AFF jump is about $250.00. AFF jumps two and three, with two instructors, run about $150.00 while jumps four through seven, with one instructor, are about $100.00. Then the price drops to about $10.00 per jump if you have purchased your own equipment and do not have to rent it.

Tandem jump exit

—**Tandem jumps** require only a brief checkout before you are attached to the front of a certified instructor with oversize parachutes. You are carried as a passenger throughout the jump from exit at 5,000 feet or higher, into freefall, and under the canopy for about four minutes flying time to landing. After opening at 3,000 feet, your instructor will probably let you steer the canopy.

Tandem jump under the canopy

Tandem equipment is highly specialized. The main canopy is much larger, a drogue chute is used in freefall to slow the descent and assure stability and the student's harness is designed to snap onto the instructor's. Tandem rides are almost carnival-like and appeal to the very young, the very old and the very scared. They are also used as part of AFF and static-line orientation courses to introduce students to canopy flying. Tandem training may be substituted for static-line training if you attend a static-line first jump course. The cost for a tandem jump is around $150.00.

The choice. Each of the three methods of training offer you the opportunity to exit the aircraft, feel the parachute open and fly the canopy to the landing area. Tandem training will either be a *carnival ride* or a substitute for static line jumps so let's compare the static-line instruction with the AFF method.

The basic static-line course consists of 15 jumps. At this point you will have spent about $1,300.00, have accomplished all the basic freefall maneuvers, be qualified to make 60-second freefall jumps and have amassed over four minutes of freefall time. Of course, prices vary from school to school.

The AFF program consists of seven jumps. At this point you will have spent about $950.00, have accomplished all the basic freefall maneuvers, be qualified to make 60-second freefall jumps and have amassed almost six minutes of freefall time. The prices in either program will be lower once you purchase your own parachutes. Whether you choose static line or AFF, your skill level at the completion of the program will be about the same, but AFF provides you with more air time for fewer jumps and less money.

If you want the thrills of freefall and canopy flying without lengthy training, choose tandem jumping. If you want to make just one parachute jump by yourself, choose static-line training. If you plan to stay in the sport, AFF is the easiest, fastest and (ultimately) least expensive way to learn. Some commercial centers will offer combinations of jumps in packages. For example, you might make three tandem jumps and then continue with accelerated freefall.

For clarity, the rest of this Chapter will assume you are in the static-line course. Once you are off *the rope*, most experiences and principles are the same.

Training verification. After completing the first jump course, you will be required to pass oral, written and practical tests before making your first jump. The practical tests will allow you to actually

demonstrate the reactions and skills you have learned. They will provide both you and your instructor with the confidence that you have learned enough to make a safe parachute jump.

Students are required to explain and demonstrate their skills prior to each jump. This training verification is especially important if the student has not jumped regularly. Layoffs of 30 days or more require refresher training. Experienced jumpers qualify for annual, renewable licenses (Classes A, B, C, and D) which demonstrate their qualifications and currency.

Instructors are certified by the United States Parachute Association and the Canadian Sport Parachuting Association as being properly trained for each type of instruction. All instructors are not necessarily checked out on all three training methods: static line, AFF and tandem. Ask to see the credentials of your instructor to verify that he or she is appropriately rated for the type of training being offered.

Insurance. The insurance covers personal liability and property damage and covers you in case you descend into the spectator area or damage a fruit tree. USPA provides this insurance coverage as part of their membership; this is one of the major benefits in joining.

Regulations. The Federal Aviation Administration (FAA) has a number of air traffic regulations affecting pilots of jump aircraft. In addition, there are a few for the individual skydiver: You must not be under the influence of alcohol or drugs and you should know that the reduction in air pressure at

higher altitudes often magnifies their effect. You must have two parachutes, a main and a reserve. The main parachute must be packed by the person using it or a certificated parachute rigger within 120 days of use, while the reserve must be inspected and packed by a certificated parachute rigger within 120 days of being worn. Skydivers making night jumps must carry a light. Seat belts must be worn when the aircraft is taking off and landing.

A few states and some local communities have regulations affecting parachuting activities. Most restate some of the Federal Aviation Regulations (FARs) or USPA's Basic Safety Requirements (BSRs).

The United States Parachute Association (USPA) Basic Safety Requirements (BSRs) require (among other things) that students use ram-air (square) canopies, piggyback containers, automatic activation devices (AADs), rigid helmets and flotation gear (when jumping in close proximity to water). The BSRs have evolved over many years and reflect commonly accepted standards for safe parachuting. See the BSRs in Chapter Four.

Each drop zone will have its own local rules. Many of them will reference local hazards such as roads, powerlines, bodies of water and unfriendly farmers.

Automatic activation devices. AADs are mechanical devices designed to open the parachute container when the skydiver is below normal opening altitude *and* is exceeding a certain speed. For example, it will not fire when you descend through 1,000 feet under a properly flying canopy but it will release the reserve canopy if you descend past 1,000

feet in freefall. AADs are intended to be back-up devices only and should not be relied upon. Being mechanical devices, they are subject to failure. See the Equipment Chapter for more information on AADs and remember there is no substitute for proper action on the part of the skydiver.

Packing. You will probably begin learning to pack the main parachute after your first jump. Learning may take 10 to 15 packs and jumps. Once you are signed off to pack your own main, you will save the packing charge which is as much as $10. Your reserve parachute will be serviced by a federally licensed parachute rigger every 120 days. Riggers usually charge about $35.00 to air, inspect and repack a reserve parachute.

Spotting. By the time you reach 15 jumps and are doing your own *spotting* (selecting the exit point), you will be signed off again and will no longer require a jumpmaster. More on spotting in Chapter Six.

Equipment. After a few jumps, you will purchase your gear to avoid the rental fees. Like skiing, parachuting is cheaper when you own your equipment. Experienced jumpers pay $10 to $15 per jump depending upon the altitude they want. They will spend from $800 to over $3,000 for equipment depending upon whether it is new or used, plain or fancy. See the buying discussion in the Equipment Chapter.

Flying. For many parachuting students, their first jump is also their first airplane ride, and it is for this reason that many instructors will encourage you to take an observation ride first. You will wear

a parachute and will be strapped in with a seat belt right next to the door so that you can see the jumpers leave. In fact, they may have to crawl over you to get out the door.

Practice Ripcord Pulls. When making your static line jumps, beginning with the first or the third, you will be making a PRCP or *Practice Rip-Cord Pull*. As you make your exit and go through your count, you will extract a ripcord handle from its pocket. Instead of being connected to your main container, it has a brightly colored *flag* so the jumpmaster can see it as you fall away from the jump plane. If you make a good PRCP on three successive jumps, you will go on to freefall on jump number six. Your instructor will try to schedule your training so that your last PRCP static-line and your first freefall jumps are on the same day. If your jumpmaster is assisting the deployment of your pilot chute as they do in Canada, instead of using a static line, your PRCP will be called a *Training Pilot Chute Toss*.

All jumps are recorded in your log book

Log book. During your entire student career, you will be under the direct supervision of a rated instructor or jumpmaster. You will keep a log book, and your jumpmaster will help you to write in all the particulars from each jump. For you, the log will be a great source of pride, something you will keep and cherish forever. For the jumpmaster, it will be a reference so that he can refresh his memory and monitor your progress.

Advancement. Once you begin your parachuting training, your progress will be limited only by your initiative and wallet. Whether you start with static line, AFF, tandem or a combination, there is a lot to learn in the first 20 jumps. For the quickest progress, make two or three jumps per day, don't take any weekends off, even take two weeks leave from work if you can. Gaps in training require retraining and retraining means lost time and greater expense. It is highly recommended that you digest this manual prior to the first jump course. It will place you far ahead of your classmates.

Measurements. You will note as you read, that measurements are given interchangeably in English, metric and navigational figures and you will encounter the same situation on the drop zone. Altitude is usually given in feet, wind speed in knots, landing measurements in meters, descent speed in feet per second, climb rate in feet per minute, etc. Because of international competition, the sport of parachuting converted some measurements to metric some time ago. In this text, many measurements are provided in two sets of figures and many of the conversions are approximate. For further help, consult the conversion chart in Chapter Two.

Progress. The sport of parachuting is undergoing revolutionary changes. While round canopies, chest-mounted reserves and static-line training were yesterday's standards, times have changed. Today, ram-air wings provide reliable openings, more interesting rides and softer landings. Piggyback containers offer greater comfort and freedom of movement. And optional training methods such as AFF and tandem are replacing static-line instruction. This book has tried to reflect these changes.

This manual is designed as a basic handbook, a training text to be used in conjunction with your first jump course. If there is anything here you do not understand, ask your instructor or jumpmaster. That's what they are there for.

> *You already know parachuting is fun. Don't worry about it; think about it. Don't guess about it; find out about it. Don't fumble around; practice. And hang around that drop zone. You don't learn about parachuting by talking (or bragging) to your whuffo friends.* - George Wright.

This is an actual letter from a first-jump student to her friend, written a few years ago. Today, you are more likely to be taught by a coach than a drill instructor. (Reprinted from *Parachutist* magazine.)

"...Let me tell you about my latest hobby—Sky Diving! I think I probably told you ages ago that I was trying to muster up the courage to start, well I have.

"I finally screwed my courage to the sticking place and rolled along to class.

"The first night was fine, it was all theory. It started out with a guy telling us that a parachute was the safest piece of equipment known to man and then spent 2 1/2 hours telling us about all the things that can go wrong and what to do about them! A thoroughly frightened girl rolled back home again but turned up the next night for some of the practical work which included learning how to do a proper parachute landing fall (or PLF) and a practice of emergency procedures in a suspended harness. PLFs are first practiced on the ground; just try falling over in one fluid line touching the ground with your calf, thigh, buttock and shoulder. Being a fairly athletic person you might manage it. I, who hadn't done anything more strenuous than lift a drink in years found it sheer, unadulterated agony. I was aching by the time the instructor (a cold-hearted bastard if I ever met one) decided that we would go on to repeating the exercise from a four foot platform. By this time a whole lot of muscles I never knew I had were beginning to complain, after two hours of jumping off that platform they were not only complaining, they were mounting protest marches accompanied by brass bands playing the *Star Spangled Banner*. I found myself unable to climb up the ladder onto the platform let alone fall off it and not add yet another bruise to what I already knew was going to be a most impressive collection.

"Just when I was determined to knock myself out on the next jump the guy called for a break (working the same principle as torturers of letting their victim almost die and then letting them rest up just long enough for a spark of life to return).

"During the break, one of the guys there asked what had prompted me to try sport parachuting, since the only girls he had known who tried it were girls whose boyfriends were jumpers. With a light, brittle, insouciant laugh I replied that I thought it might be a bit of a *giggle*. Then comes this lugubrious voice from my instructor, *Yea, I've been laughing ever since you arrived*. Encouraging bastard!

"However, no rest for the wicked, out again we were forced to go through the emergency release procedures in a suspended harness. This involved climbing up a little ladder, getting strapped into a harness standing there until the Man, almost with studied insolence, kicks away the ladder and you just dangle there (shades of Tom Dooley). An instructor on the ground calls out various malfunctions that you might be faced with and you go through the corrective procedure. There are some types of malfunctions for which you have to get rid of the malfunctioning parachute and pull the emergency parachute ripcord. Getting rid of the main involves pulling the release handle and upon dropping away, pulling the reserve.

"There I am, dangling in the breeze with aching muscles, bruises coming up all over my body in most tender spots (I just knew I wasn't going to be good for anything... for weeks) and a whole crowd of guys who had already been through all this watching with interest—knowing full well what would happen. The instructor calls out a particular type of malfunction for which I have to cut away and I start to go through the procedure, comes the moment when I pull the release handle to get rid of the main parachute and only one side works! I swing round in a small circle and dangle there by one strap—to the great delight of all the S.O.B.s sitting on the ground watching.

"*Don't just hang there, woman*, calls out my instructor/tormentor—for whom by now I have conceived a blind, murderous passion—*Grab it and pull hard*. (I know that by now you are there ahead of me as to what I would have liked to have grabbed and pulled hard.)

"O.K. *Pull*, the man said, so I use both hands and the thing releases, I collapse in a heap on the ground and just lie there wishing, nay praying, that the ground would open up and I would fall through to discover myself on some warm beach in Australia.

"I lie there and realize that the crowd is laughing more than the sight of me falling in an inelegant heap warrants. I look up and my instructor comes up, lays his hand on my shoulder and whispers softly to me: *Lady, you're dead! YOU FORGOT TO PULL YOUR RESERVE!*

"Thankfully I lay back: if I was dead that meant I could just lie there on the nice soft green grass. Unfortunately that didn't work either. The harness had a number of straps attached to it and I was unceremoniously hoisted up by one and forced by that sadistic brute to get back up there and go through the whole thing all over again. What I felt for Pansy-Petunia, my fairy-riding ground instructor by now can be regarded as sheer love compared to what I feel for my jumping instructor.

"Anyhow, to cut what might be a long story short, I managed—by being forced to return for an extra night's torture—to be told I could jump on Saturday. Quite frankly at that point I would have been the happiest girl in the world if they had told me there was no way they were going to let me jump, but alas, no such luck. I went home on Friday night and my boyfriend had a lovely evening giving vent to his sadistic tendencies by pounding me with horse embrocation in an attempt to stop my muscles from seizing up altogether.

"Saturday morning I drive out to the airport, some 50 miles away, all by myself as my boyfriend has announced that he does not approve of what I'm trying to do and wants nothing to do with it; he does not even, in fact, want to hear about any of it. I felt a bit like the condemned man must do walking his last 200 yards—in my case I remember each of the 50 odd miles with incredible clarity, the sights, the smells, the sounds, everything. I spent several minutes reviewing all the past loves of my life surrounded by great clouds of nostalgia and finally arrived at the airport feeling quite mellow. There I was most unceremoniously dressed up in a set of overalls, glamorous boots (ugh!), and a helmet on top of which went miles of harness, a main parachute, and a reserve. At this point I felt like a cross between the Michelin man and a Dalek and just couldn't procrastinate any further by asking to go to the john! (A procedure which would have meant asking for help with getting all unstrapped—humiliating!) With the original sinking heart I followed the instructor and another student jumper out to the plane where I almost gave up for the third time that

morning (What, me go up 3,000 feet in that thing? It doesn't look safe.)

"My pet sadist insisted that I be first out despite my protests that I was a convinced lady libber and saw no reason for women to be accorded false courtesy. I was just told to *quit bitching* and get in. It took the jumpmaster hauling on me from behind and the pilot pulling from in front to get me into the plane as I was not only encumbered by the bloody great parachute but inexplicably, my legs had totally refused to function. Whether this was a result of the punishment I had taken over the last few days or just sheer funk I'll never know. With me sitting praying to all the saints and angels the plane wobbled into the air. My suddenly remembering that my library book was overdue and I had to go return it didn't even merit a comment other than a grim muttering about there being only one way I was leaving the airplane...

"We got up to the height from which I was going to jump, by this time I was so scared that even my tormentor was taking pity on me and making soothing noises. Either that or he didn't know how he was going to get the other student out of the plane if I jammed up in the door and refused to move!

"Well, there we are. *Get in the door*, he says, this means I have to swing my legs out of the open door of the plane and wait there until we are over the drop zone. I swing my legs out (not strictly accurate, the pilot and jumpmaster push them out for they have again refused to move), the wind almost whips them off at the hips. The pilot cuts the engine—this to reduce the prop blast—and the guy says to me *Get on the step*. This means I have to grab the wing strut and pull myself out of the plane doorway and balance on the jump step waiting for the command *GO*. This I do, because by now I'm so scared I no longer even remember what I am doing. Seriously, I don't remember getting out there the first time, I only know I must have done it because I remember balancing there thinking *Am I never going to get the go signal?* When it came—a slap on the butt and a shouted *GO!* it was such a relief that I jumped off backwards (as prescribed) without any hesitation (anything to get off that damn step)!

"I then really blew everything. The thought flashed through my mind, *What the hell am I doing?* The realization that I was falling through space followed instantaneously and my instinc-

tive reaction—out of sheer terror—was to curl up into a fetal position. Totally the wrong thing to do as I was later unceremoniously told, at that point though I wasn't all that concerned. I had got down and that was all that mattered.

"However, before I had time to do any damage the parachute opened, and I was pulled up short. This has to be the most tremendous sensation going, the first thing that struck me was the quiet. It was timeless and spaceless and a brief glimpse of a totally undemanding eternity. For a few moments—before I had to start worrying about my landing—I had some sensations that I have never had before, a total bodily involvement in a medium that was a tremendous high. People have all sorts of ways to *get off*, to experience that extra kick from life.

"I've found my thing: I'm hooked."

I've found my thing. I'm hooked!

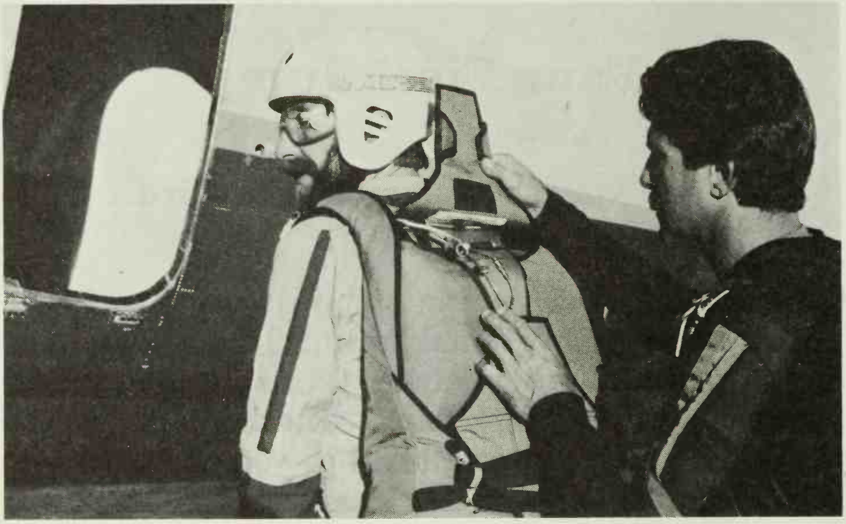
Chapter Two

Your First Jump

and your second and your third...

The next step is the big one. Now that you have completed your ground training, both classroom and outdoor, you are ready for that long, lonely leap. In some ways it is probably unfortunate that the jump won't be as great a thrill as you expected it to be. After a reading of this chapter and taking the first jump course, it will all seem so simple, more like your second jump than your first—as though you have been here before. But this familiarity only reflects your understanding and mastery of the basics of sport parachuting, which are essential ingredients for safe, enjoyable jumps. It is the purpose of your ground training to duplicate as closely as possible what you will find in the air. Yes, *the best surprise is no surprise*, particularly in parachuting.

Equipment issue. Now that you have completed all the necessary preliminaries, you will be issued your parachutes. There are two of them in there, a *main* on the bottom and a *reserve* on the top. If you were not wearing a jumpsuit and helmet for the first jump course or if this instruction took place on another day, you will get them now too. Your jumpmaster, who may or may not also be your instructor, will help you into the 25 lbs. of well-engineered nylon. Most of the weight hangs heavily on the back and tugs at the shoulders as it grips you tightly. It makes you somewhat clumsy as you move about and reminds you what life would be like if you were overweight.



The equipment check is made prior to boarding the aircraft

Equipment check. No doubt, you and your classmates have been signed up or *manifested* for a separate student flight, so your jumpmaster will be the only experienced jumper on board. (Later in your jump career, you will share the *lift* with other parachutists of varying levels.) Your jumpmaster

will line you up on the *flight line* for the equipment check. This is where jumping begins to seem sort of military and, indeed, many of sport parachuting's training and jump techniques have been adapted from the armed services. The *equipment check* is the final visual and physical inspection made by the jumpmaster on all parachutists prior to boarding the aircraft. It is sometimes referred to as the *pin check,* but many things are checked besides the pins. The pin check is a systematic inspection of the entire parachutist both front and rear, from top to bottom. If for any reason the flight is delayed, the check will be made again. The jumpmaster will present himself for a check by another experienced jumper. The equipment check is so important that there is a complete discussion of it in the equipment chapter.

Teamwork. The pilot and jumpmaster work as a team with the pilot being primarily responsible for the aircraft and the jumpmaster taking charge of the contents. While technically, even legally, the pilot is *captain* of the ship, these two must and do work together. Misunderstandings are most easily avoided when the pilot communicates with the jumpmaster, and the jumpmaster directs the rest of the jumpers. Student lifts are pretty routine, so the planning is not complex.

Aircraft. Jumps can and have been made from just about every type of aircraft and airplane, but some are much more suitable than others. Since the object of the plane ride is to get up in order to come down, a high-wing model will offer greater visibility in the direction which interests us most. Low-wing airplanes not only have limited downward visibility, they also do not offer exit aids such as a wing strut

to grip and a wheel or step to stand on. Seventy percent of the parachute operations use high-winged Cessnas carrying three to four jumpers and a pilot. You may jump from a low-winged monoplane such as a Piper Cherokee 6 or even a helicopter if you are in a military sport parachute club. For larger team jumps, you may leap from a Twin Otter, Skyvan or DC-3. Whatever the aircraft, you will receive special instruction in boarding and exits.

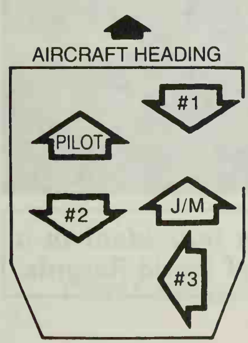
Never walk around the front of an airplane or the tail of a helicopter.

The single-engined monoplane will have all seats but the pilot's removed and will be otherwise stripped out for jumping. Upholstery provides comfort you won't be needing as you are well padded and making a short flight. Jump gear tears upholstery quickly anyway. Like extra instruments and even fuel, upholstery contributes to the weight of the overall flying machine, and it is just not economical to carry it up to altitude on a short flight only to bring it back down. The aircraft will be prepared for jumping by taping over any sharp objects and removing protrusions (such as handles) which could snag your gear, especially near the

door. The door will either be removed or refitted with a model with hinges on the top, to permit opening and closing in flight.

Boarding the aircraft

Boarding. When the airplane arrives, follow the commands of your jumpmaster. Always approach airplanes from the rear and helicopters from the front. If you are suddenly reminded that you need something from your car, walk away from the prop or tail rotor. Spinning propellers are difficult to see, particularly in all this excitement, and they are very efficient meat slicers. And, incidentally, if you really love your dog and your rug rats, leave them home; an airport is a dangerous place to romp and play. Smoking isn't allowed around fuel-laden aircraft or the fuel pumps.



Typical Cessna seating arrangement. The jumpmaster dispatches the students in the order shown.

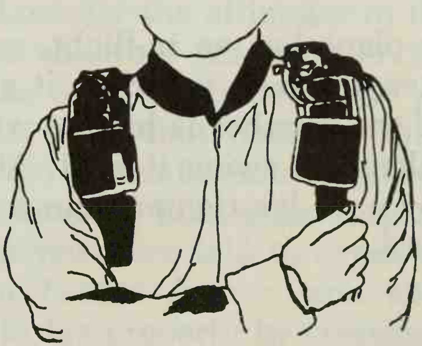
You will board the aircraft in the reverse order of exit. The last one in will be the first one out. Boarding may be in a random manner or the jumpmaster may place the heaviest students forward to improve the takeoff and flight characteristics of the plane. Some jumpmasters like to put the female students out first on the theory that their male classmates won't balk. Actually, very few students refuse to jump once aloft, but you have a right to do so. There is nothing wrong with changing your mind and riding down with the aircraft. The jumpmaster will be boarding last.

For your own piece of mind, yank on the static line to confirm its security

Skydiving: The highest speed reached by an individual in a non-mechanical sport. - The Guinness Book of World Records.

If your first jump is with a static line and this is a large aircraft, your static line may not be hooked up until the plane has climbed past 1,000 feet or until just before your jump. But most jumpmasters prefer to hook up their students before cramming them into a small jump ship. In either case, it is your responsibility to confirm that your static line is hooked up. Tug on it after it is snapped closed and again on jump run.

Guarding and routing the static line. The jumpmaster will help you into your seating area. The parachutes are heavy and tend to pull you backwards when you sit down. You are inclined to lay back and relax as best you can, but you should be sitting upright. Lounging takes up more precious floor space and may bring your pin in contact with the seat runners and other objects on the floor. This could cause the main to open in the aircraft, which is troublesome, expensive and sometimes dangerous. Other good reasons for sitting up straight are that you may be able to see out the windows, and it will be easier to get up when the time comes.



Cover and guard the ripcords and canopy release handle

Your static line will be routed over the shoulder farthest from the door, S-folded to take up the slack and placed in your hand. Your other hand should cover your breakaway, main and reserve handles. Until you are completely out the door, your two most important responsibilities are to guard your static line and your handles. Also monitor your classmates to make sure they have both hands full. If you are equipped with an instructor-assisted deployment system rather than a static-line rig, guard the pilot chute in its pouch.

Seat belts. The Federal Aviation Administration requires that seat belts be provided for all passengers for use in take-off and landing. Your jumpmaster may instruct you to release the seat belt right after take-off. Belts are secured across the lap, where you have bulky clothing and a lot of other straps so the buckle could be very difficult to locate in an emergency. In a takeoff crash, those in the rear might be trapped by those in the front who are trying to find the buckle. On the other hand, if you are sitting by an open door, you will feel more secure with, and should wear, the seat belt.

Door. If the plane has an in-flight, swing-up door and it is winter, the pilot will close it as soon as all are aboard. If the weather is hot, he will wait until just before takeoff to swing it shut. All of you are pretty close by now; it's tighter than a phone booth jamming contest.

You swallow hard, thinking to yourself, it must be all right, thousands of people have done it before. Then . . . but this time it's me - that's the difference! - Charles Shea-Simonds.

Takeoff. The pilot starts the engine and taxies out to the end of the runway. Turning the plane away from the runway, he locks the wheels and gives the engine some fuel, making it roar. The plane vibrates all over as the engine and prop strain against the brakes and you get the unmistakable airplane smell of wind and exhaust. He glances over the many instruments and checks the *mags* (magnetos are part of the engine's electrical system). Then he checks the sky for other aircraft, spins the plane around to the *active* runway and rams the throttle home. In most planes, it helps if everyone leans forward. There is so much dense cargo that just a small bit of forward-shifted weight makes a big difference. After takeoff when the pilot raises the flaps, reduces power and trims out for climb, you can sit back.

Climb out. Your jumpmaster will probably try to add to your education and, at the same time, occupy your otherwise nervous mind by bringing a number of interesting things to your attention. If you are like many first-jump students, this may be your first ride in a small plane or even any aircraft. For you, this is a never-before-seen sight and it is particularly exciting. Look for the altimeter in the instrument panel or the one your jumpmaster is wearing. At 200 feet, take a look outside at the ground so you will recognize how that altitude will look during your parachute descent when it's time to turn into the wind for landing. Locate the target and any hazardous areas you were told to avoid in class. Some DZs have a *hostile farmer* who keeps the gear brought on to his property by trespassers. Find the pond, the powerlines, the road; get oriented. Now which way is the wind blowing? Look at the wind sock.

Keep your movement in the plane to a minimum or you will wear out the pilot. The aircraft must be balanced or the pilot has to correct with the controls. Imagine driving your car with a soft front tire, first on one side and then the other. The tires would pull to one side and you would have to apply constant pressure to the steering wheel to keep the car straight. But the pilot has an adjustable trim tab to relieve this pressure and he will readjust the trim every time you move. Relax and enjoy the view. Your ride up will take around ten minutes.

The seat belts come off at 1,000 feet if not before. Unbuckle yours. When not in use, seat belts should be stowed out of the way. Slide the hardware to the end of the strap and lay it on the floor as far from the door as possible. A metal-tipped seat belt trailing out the door may chip the paint or make a dent in the fuselage. Seat belts should never be fastened together except when worn. Loose, fastened belts can catch legs as skydivers scramble during exit.

Wind determination. Unless this flight followed the previous lift by just a few minutes, the jumpmaster will be preparing to drop a wind drift indicator, a piece of weighted crepe paper measuring 10" x 20' and designed to descend at the same rate as a jumper under an open canopy. The jumpmaster will use the WDI to determine the exit point. Wind varies in speed and direction at various levels. It may be calm on the ground and blowing briskly at jump altitude. With accurate wind information (which way and how much), he will be able to select the best place for your exit so that you will drift into the target area. There will be a detailed explanation of *spotting* in a later chapter but here is what you

will experience the first time. At 2,500 feet, the pilot will turn approximately into the wind (according to his best guess), fly across the DZ, or *drop zone*, and open the door. The jumpmaster will look out and down, relaying corrections to the right and left and then will throw out the wind drift indicator as the aircraft passes over the target. Banking slightly to the right, the pilot will continue to guide the aircraft in its climbing turn while the jumpmaster keeps the indicator in sight. During the next two and a half minutes the streamer will become smaller and harder to see as it descends to nature's camouflaged terrain. Noting the distance and direction from the target, your jumpmaster will select an exit point an equal distance upwind of the target.

Some clubs teach their students to *spot*, or select the exit point, right from the first jump. This early training keeps their mind occupied, off the worries of the jump, and gives them more confidence and a feeling of being useful. Some other operations start spotting practice on the second jump and many wait until the tenth jump or so.

Jump run. As you near 2,800 feet on *base leg* and are about to turn onto *jump run*, your jumpmaster will relieve you of your handful of static line and point out three important things: the *target*, the *exit point* and the *wind line* which runs through them. If you are rigged for Instructor Assisted Deployment, he will remove and fold your pilot chute.

> *Never in my life can I remember such a feeling of accomplishment.* - Michele Gratton.

Jump run. The pilot and jumpmaster are busy with last minute details such as giving you a good spot.

After turning on jump run, the pilot will reach over and unlatch the swing-up door. The wind will pull the door open, holding it snugly up against the underside of the wing. The jumpmaster will stick his head out as the jump ship flies upwind, crossing the target and heading for the exit point. He may give the pilot some slight course corrections either verbally or with hand signals. You will notice the buffeting, cool wind, the noise and smell of the engine, and it will be hard to hear. At this point, your jumpmaster may give you a little pep talk and review of the essentials: *Protect your handles and your static line as you move about the aircraft. Take your time—I'll do the rest. Remember as you climb out: left foot, left hand, right foot, right hand. When I slap you and yell* GO!, *I want to see a hard arch. Look up and keep your eyes on me and your position will be good. We will be listening for your count but you will have to shout as loud as you can. Don't be afraid to pull the reserve if you only* think *it may be necessary. And don't forget to face into the wind on*

landing; today that means toward the gas pumps. Think and make it a good one. See you on the ground. Or, his last minute advice may consist of just a few words. It is largely a matter of individual style.

In the door. The wind will probably try to blow your feet away from the step.

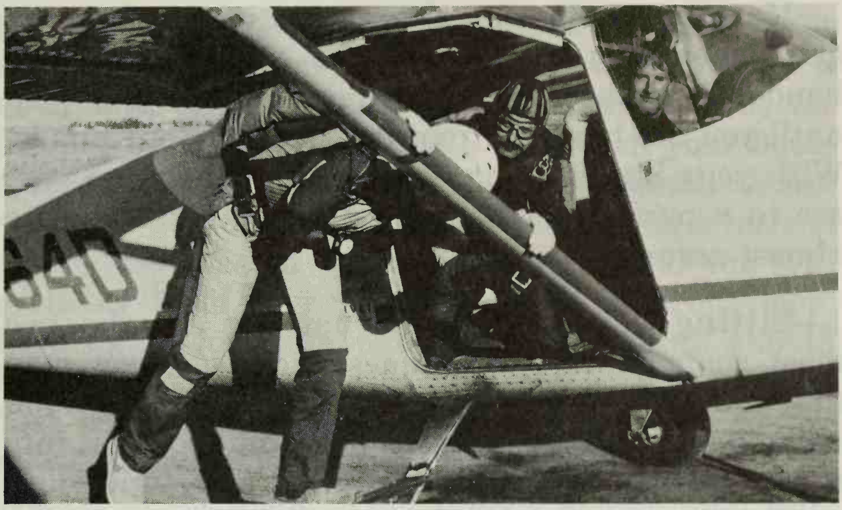
Just before you cross the target, about ten seconds from exit, your jumpmaster will give you the first exit command: *SIT IN THE DOOR!* Swing your legs out while continuing to guard your ripcords and canopy release handle and visually monitoring the routing of your static line. If it snakes under your arm, you will get a rude awakening when you reach the end of it. Also watch your jumpmaster's ripcord handles; don't knock them out. Leave some room in the doorway so your jumpmaster can peer over your shoulder at the exit point. Once you are out on the step and clear of the door, you may discontinue guarding the handles. Grasp the wing strut with your left hand and the edge of the door with your

right. It will be very windy in the prop blast. Do not at any time grab the hand strap which may be over the door; they pinch fingers. It will be harder than you think to place your feet on the step because of the wind blast.

Exit. About three seconds prior to exit, the jumpmaster will yell *cut* and the pilot will throttle back the engine. The noise will fade and the plane will slow down. Just how much the pilot slows the airplane will depend on you and your size because here we have a tradeoff. If you exit at 85 mph, the higher speed will provide you with more body control, and parachute deployment will be cleaner. However, all this wind makes climbing out and holding on more difficult, so for smaller, weaker students the pilot may throttle back to 75 mph.

GET ON THE STEP shouts your jumpmaster with the second exit command. Now reach across vigorously with the right hand and grasp the strut about one foot out from the door, hooking your fingers around the leading edge. Look forward to the strut, and your body and feet will turn toward it. Now pull yourself onto your feet on the step. If you have short arms, you may have to proceed one grip at a time, and you may require some help from your jumpmaster. Do not try to reach out too far or you could lose your grip or balance. You may be taught to make a poised exit or a hanging exit.

On unstable exits, students get a glance at the airplane only about once on each revolution. - Don Grant.



Poised exit. The traditional method.

—**Poised exit.** Standing on the step with your left leg, let your right leg hang in the breeze. Or your instructor may teach you to place both feet together out on the end of the step. Support your weight with your leg(s); your handholds are only for keeping you oriented and balanced.

Hanging exit

—**Hanging exit.** An alternative is the hanging exit, where you go out past the step, sliding your hands along the strut while maintaining your grip until you are hanging from the strut by your hands. With your legs blowing back in the slipstream, you are in a perfect position and a clean, stable exit is almost assured.

—**Sitting exit.** Poised and hanging are the two most common exit techniques. However, you may find yourself jumping from a Cessna 206 where you have to sit on the floor in the door and scoot out into the prop blast. Whatever aircraft and techniques you encounter, your instructor will train you for the necessary exit.

Now that you are set, get your head up and turn it to look your jumpmaster in the eye.

Go!

The jumpmaster will emphasize the third and final command GO! often with a sharp slap across your thigh so you will know he is yelling at you. If you feel anything besides a slap on the thigh, don't

jump. You may be past the spot, or for some other reason he may want you to re-enter the plane for a go-around. On GO!, simply step off to the side (or just let go in a hanging exit), then arch your back, spreading your arms and legs. Stretch those muscles! Your body will follow your head which is led by the eyes. If you are looking down, you will probably bend over forward and do a front loop. Look up at your jumpmaster and the result should be a good arch. Pointing your toes also helps. The best body position on exit is perpendicular to the relative (on-coming) wind, about 45 degrees to the ground. If the angle is much more or less than this, a slight rotation of your body may result. At this point in your jump career, your exit position is more important than your body form since you don't have enough airspeed to correct for a poor exit. Make a stable exit. Simultaneously with your exit, you will shout your count, beginning with *Arch thousand.* The arch and count may be practiced at home using a table. They should be practiced until they become smooth and automatic.

EXITING THE AIRCRAFT. Attaining and maintaining the proper body position. Illustrations are for C-180 aircraft. Instructions will be altered by your jumpmaster for other aircraft. The exit and count should be practiced until they become smooth and automatic. Your *exit position* is more important than your *body form*; you don't have the airspeed or time required to correct for a poor exit. Your jumpmaster will give you these commands.

A. IN THE DOOR. Swing legs out into the wind and grasp the wing strut with the left hand. Protect ripcord handles and canopy release until clear of the door.

B. ON THE STEP. Pull yourself out on to the step and face forward grasping the wing strut firmly with both hands. Keep your head up and look at the jumpmaster.

C. GO! Side-step off to the right.

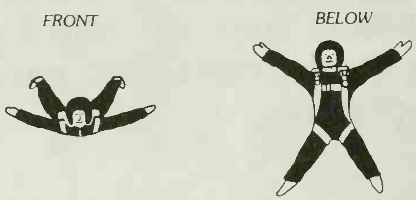
NOTE: Your DZ may teach the hanging exit.

1. ARCH-THOUSAND! Arch your back. Keep the head up and look at the jumpmaster. Start the count sequence out loud:

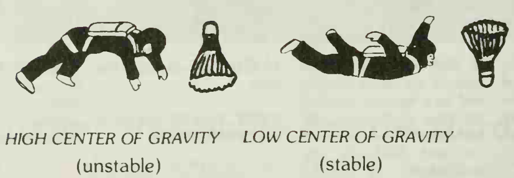
A capsulized review of the poised exit from a Cessna 180 aircraft

It is very unlikely that you will hit the tail of the airplane as you exit. Because you are going the same speed as the aircraft, you will carry forward on exit, appearing to drop almost straight down from the door.

As you fall away, the jumpmaster carefully monitors your body attitude and allows the looped static line to pay out of his hand. He will allow you to fall to the end of the ten foot line unless you begin to roll. In this case, he may choke off the S-folds in his hand and *short line* you, initiating an earlier deployment, reducing chances of entanglement. He is also making a mental record of your air work which he will discuss with you in the post-jump critique.

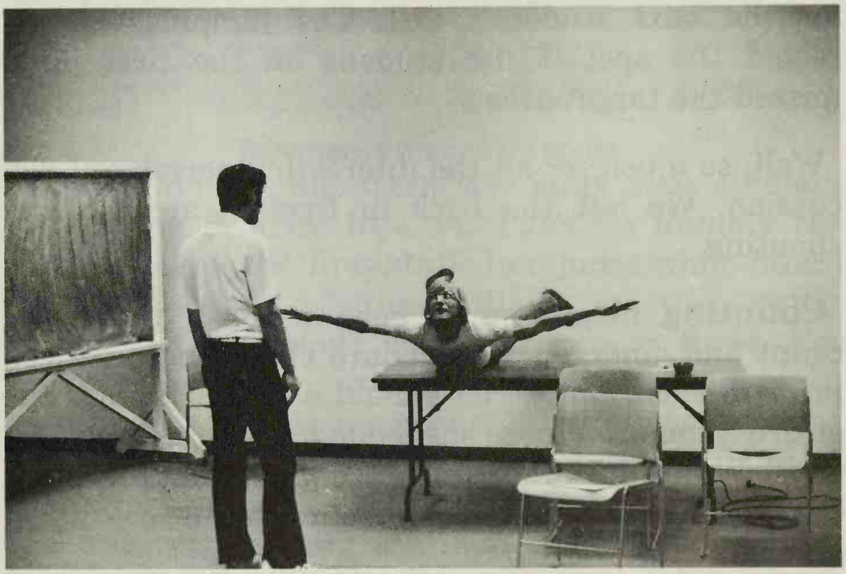


The spread stable position



The body compared with a shuttlecock

Stability. You want your canopy to deploy while you are in a stable fall, face-to-earth, shoulders-level position so that it may develop freely, directly away from the body. A good arch will provide you with a clean parachute deployment and an easier opening. A hard arch places your center of gravity low and maintains you in a position like the shuttlecock, face-to-earth.



Practice the arch on a table

Stability may be practiced in your living room. Lie face-down on the floor with the arms and legs extended. Then, on the word *GO!* force a hard arch by lifting the arms, legs and head as high off the floor as possible. See how long you can hold this position. Keep practicing over and over. It will help you to make a better jump and it's great for the stomach muscles.

The purpose of the static-line jumps is to create a behavior pattern in your mind so that you may safely pull your own ripcord. - Chuck Ryan.

Once the static line has unlocked the container and pulled out the canopy, you are on your own; your jumpmaster can do nothing now—but watch. If you weren't the first student to jump on this lift, you saw him reel in the previous jumper's static line, unhook it and stow it either beneath the pilot's seat or in the rear of the cabin. Meanwhile the pilot was making a one-to-two minute orbit back to jump run for the next student's exit. The jumpmaster corrected the spot if the student on the first jump missed the target area.

Well, so much for all the interesting peripheral discussion. We left you back in freefall, arching and shouting.

Counting helps you to keep track of time. The count and emergency procedure should be practiced prior to each jump. You should also go through the entire sequence in a suspended harness every 30 days. While the count sequence varies slightly with changes in parachute equipment, this is the usual order.

THE COUNT.
Normal Procedure

1. ARCH-THOUSAND. Exit aircraft, hard arch, arms and legs spread. head back.

2. LOOK-THOUSAND. Maintaining arch, tuck in chin and look at the main ripcord handle.

3. REACH-THOUSAND. Maintain arch, bend arms at elbows and grasp ripcord handle.

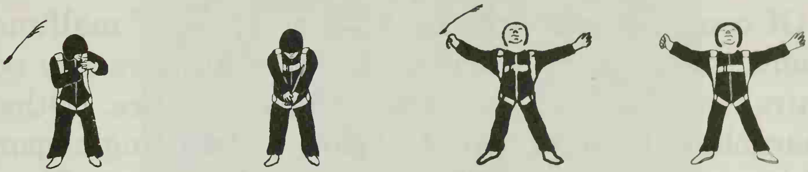
4. PULL-THOUSAND. Maintain arch, pull vigorously going back out into the spread position, head back.

5. CHECK-THOUSAND. Check the canopy (look back over the shoulder for pilot chute hesitation, malfunction, etc). Body may roll slightly.

(The canopy normally opens between REACH-THOUSAND and PULL-THOUSAND (3-4 seconds) but you must continue the count through CHECK-THOUSAND (5) and pull the practice ripcord handle. Practice the entire count of nine.)

The exit count

EMERGENCY PROCEDURE FOR TOTAL MALFUNCTION



6. LOOK AND REACH THOUSAND. Let go of the main ripcord. Locate and grasp the release handle with the right hand and twist.

7. PULL THOUSAND. Push the release handle full down with both hands.

8. SPREAD THOUSAND. Spread hands to clear cables from housing. Let go of handle. Look and reach for reserve ripcord handle. Push full down.

9. ARCH THOUSAND. Return to arch and spread. Let go of handle. (Attempt to pull reserve even if self-activated.)

Emergency procedure count

PRCP. Many jump operations start their students off making *Practice RipCord Pulls* (or *dummy ripcord pulls*) on the first static-line jump while others teach the spread position initially and then switch to the PRCP motions on jumps two or three. You must continue your count and the indicated movements until the canopy opens, bringing you upright. The canopy will normally open between *reach thousand* and *pull thousand* but you must ignore the upward pull and continue the count until you have pulled the practice ripcord. You won't graduate from the static line to freefall until you have five jumps and have demonstrated to your jumpmaster your ability to successfully pull your ripcord on three successive jumps. So, start practicing now.

As you practice your exit-count from the table and your arch on the floor, go through the entire count of nine. Practice and practice until the count and motions become automatic.

Malfunctions. Total malfunctions are rare but if they didn't occur now and then, we wouldn't bother counting past *pull thousand*. If you reach the count

of five and aren't being jerked upright by your filling canopy, don't hesitate—pull the reserve.

Of course, there are many other types of malfunctions and remedies, but only the total, normally occurs in this part of the jump sequence. Other parachute malfunctions and some interesting airport dangers are covered later in the Emergency Chapter.

Deployment bag lifting out of main container

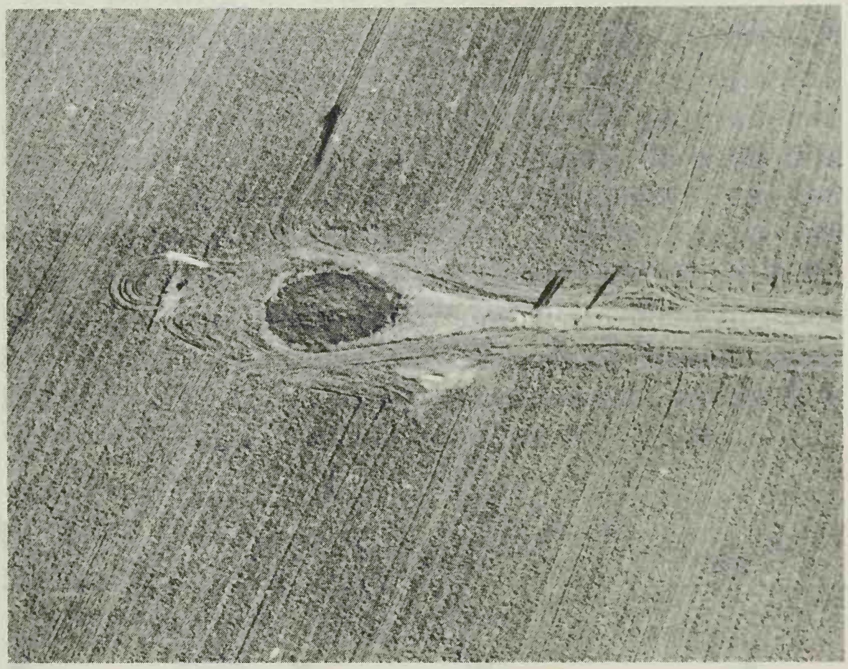
Slider slowing the spread of the main canopy

Opening sequence. When the ripcord is pulled, the main container is unlocked allowing the *pilot chute* into the airstream. Acting like an anchor, the pilot chute draws the bagged canopy out of the container as you fall away. The suspension lines unstow from their rubber bands with the last two or three unlocking the *bag*. The canopy pulls out of the bag but the *slider* under the lower surface of the canopy keeps the canopy from spreading too rapidly. You are pulled upright as the cells of the canopy inflate and spread apart. As the canopy spreads, the slider moves down the lines. Lastly, the bag and pilot chute fall on top of the canopy or trail behind it.

Deployment. As you are pulled upright by your blossoming canopy, you experience an overwhelming exhilaration. You look up to see your new nylon friend, the one who plucked you from freefall, and find the canopy to be larger than you imagined. You are at 2,600 feet and it's beautiful! The air is brisk and clean. But this is no time for sightseeing; time's a wasting and there is work to be done.

Your canopy ride has three distinct phases: the canopy check, steering for the target and preparing to land. *Look up* and check the canopy. It should be rectangular, flying straight, the slider should be down with no twists in the lines, and the end cells should be fully inflated. If the canopy is anything but perfect, you will follow the instructions as outlined in the chapter on emergency procedures. Make a *traffic check*: are there any other jumpers flying in front of you? Stow your practice ripcord handle if you have one. You may slip it down the front of your jumpsuit. Don't lose it! Dropped from half a mile up, it could injure someone on the ground and, besides, most clubs have penalties for lost ripcords, usually beginning with a case of beer. *Clear the brakes* and slider by reaching up and grasping the steering lines by their loops on the risers. Push the steering toggles down to your crotch for a count of two. If the slider does not come all the way down, push the toggles down again. Make a *controllability check*: turn right 90 degrees, turn left 90 degrees, then bring the toggles down to half brakes. *Look down* at the ground and get yourself oriented. Find the target and windsock. Determine the windline and head toward it. Check your altimeter.

Communications. Listen or watch for ground instructions as you have been taught. Your DZ may be using radios, a bull horn, P.A. system, or ground panels to guide you down. But equipment fails, drop zone personnel may be off helping the student ahead of you and, of course, it always helps to understand why you are doing what you are doing. So, read on. Fly to the *landing area entry point*.

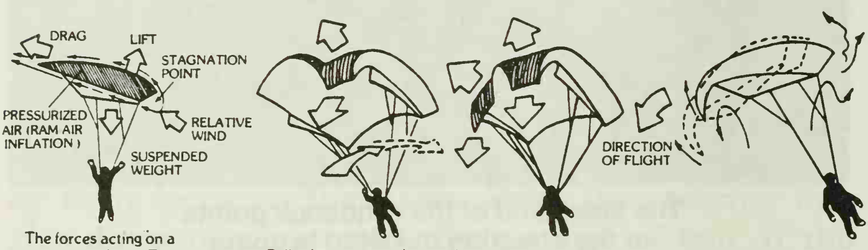


The small end of the windsock points in the direction the wind is going

Find the windsock. It will not only show you the direction of the wind, but with practice you will be able to judge wind speed by its angle. Later you will use other wind indicators such as smoke from factory chimneys, ripples on ponds, flags, etc. Winds vary in direction and intensity at different levels and wind determination will become even more important when you reach long freefalls.

Your ride from opening to landing will be influenced by four major factors: gravity, wind (speed and direction), canopy forward speed and other atmospheric conditions. While you can't expect to make precision landings right from the start, and should not try, an understanding of certain basics will enable you to avoid obstacles by steering around them.

Gravity, the first factor affecting your flight, depends on your *exit weight*—the total weight of you and all your parachute gear. If you weigh 160 lbs. and have 30 lbs. of gear including parachutes, helmet, etc., you can expect to descend at about ten feet per second. This means you will have almost four minutes from the time you open at 2,500 feet until you touch down. If you weigh more, you will come down faster. In fact, if you weigh much more, you will be issued a larger canopy and then you will have to start over on these calculations.



The forces acting on a canopy in flight. The canopy is a gliding wing.

Pull down on right toggle to go right. Let toggle up to stop turn.

Pull down on both toggles to brake the canopy or flare for landing.

Caution: Holding both toggles full down for more than a few seconds or pushing both toggles down rapidly may cause the canopy to STALL resulting in rapid altitude loss.

Basic toggle positions

1. Zero brakes: toggles all the way up for maximum speed. 20 mph.
2. 1/4 brakes: half way to shoulders for minimum sink.
3. 1/2 brakes: at shoulders to combat turbulence, for stall recovery, hazardous landings and use on final approach. 10 mph. One toggle to shoulder for turns.
4. Full brakes: at crotch to inflate end cells, encourage slider and on landing.

Flying the ram-air "square" canopy

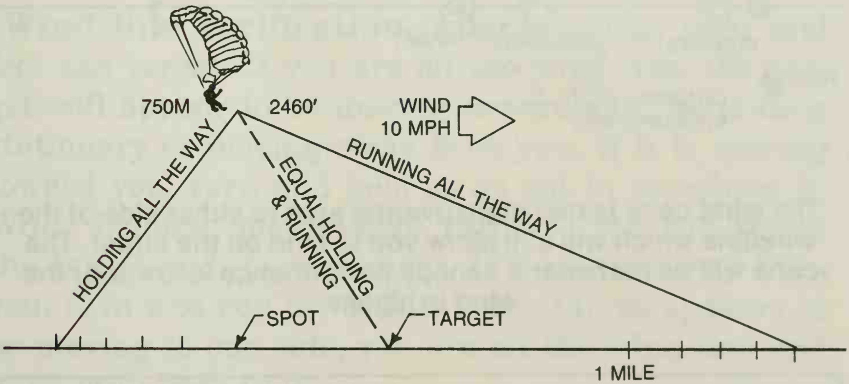
Your canopy is a collapsible, deployable flying wing held open by internal ram-air pressurization. As the canopy moves forward, air enters the holes in the

leading edge to inflate and pressurize the wing. Now if you weigh 170 lbs. you can expect a canopy speed of about 20 mph and a glide angle of 72 degrees.

Full flight. The canopy is designed to run at its maximum forward speed when the steering lines are all the way up.

The turning of the canopy is accomplished by pulling down on the steering line on the side to which you wish to turn. The faster and further you pull down the line, the quicker the canopy will turn. Fast turns also make you swing out from under the canopy in a wide arc and increase the rate of descent considerably. Because of this swinging and increased descent rate, major turns should not be made near the ground. It is best to make all turns gently. Steering lines should be pulled down in front of you where you can see your hands in relation to the turn being produced.

Braking. Pulling down on both steering lines evenly will cause the canopy to *brake* or slow its forward speed.

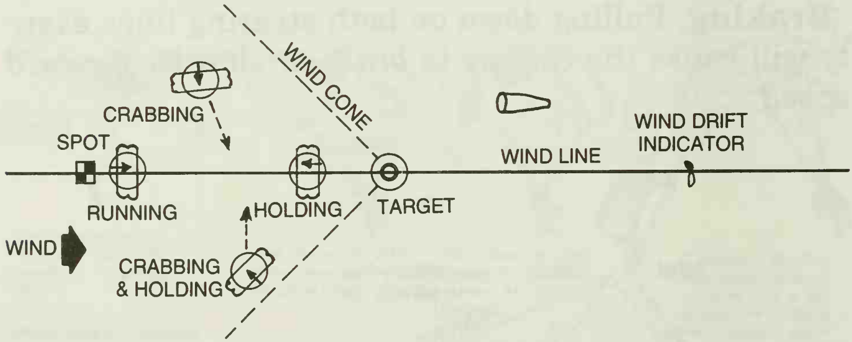


Which way is the wind blowing? Are you drifting toward or away from the target?

Upper winds. There probably isn't any such thing as a *no wind day* because there is usually some movement up there. In fact, if there is some wind on the ground, there is almost always more movement up higher. While the wind may be blowing five mph. on the ground where it can be measured, it may be blowing 15 mph. at 1,000 feet where it can't. This is because there is more frictional drag near the ground. This is just like a stream where the water moves faster in the center than at the sides. If the ground winds are 15 mph. and your canopy has a forward speed of 20, all sounds fine until you find the upper winds are 25 and you are backing up. In these conditions, once you venture downwind of the target, you will never get back.

You at 15 mph →← wind at 10 mph = a ground speed of 5

You at 15 mph →→ wind at 10 mph = a ground speed of 25



The wind cone is that maneuvering area to either side of the windline which will still allow you to land on the target. The cone will be narrower if canopy performance is lower or the wind is higher.

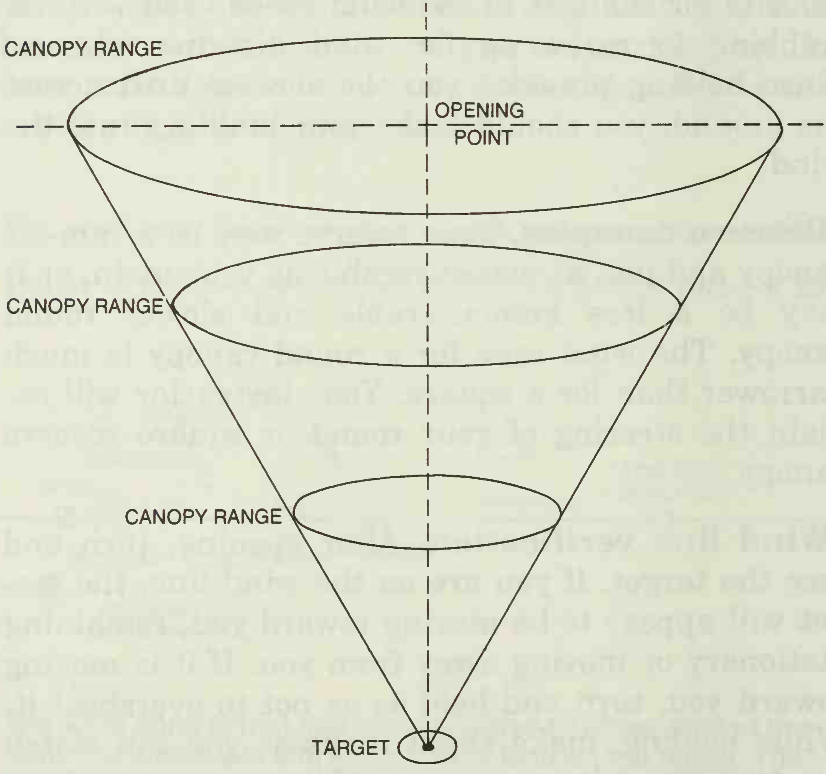
> The quiet amazes me. With the chute doing its job, the ride down is a piece of cake.

Did you open over the opening point? If you are very far upwind (*long*), you will be *running* with the wind a lot, while if you opened closer to the target than you planned, you will spend most of your canopy ride *holding* against the wind. If you find yourself left or right of the opening point, you are off the wind line and will be *crabbing* across the wind to get back to it. If the opening point was correct and if you opened over it, you will require an equal amount of running and holding to hit the target. You will use extra running and holding only to compensate for changes in the wind speed. You will use crabbing to make up for wind direction chanes. Since holding provides you the slowest drift across the ground, you should make your landings into the wind

Reserve canopies. Your reserve may be a ram-air canopy and just as maneuverable as your main, or it may be a less maneuverable and slower round canopy. The wind cone for a round canopy is much narrower than for a square. Your instructor will explain the steering of your round or square reserve canopy.

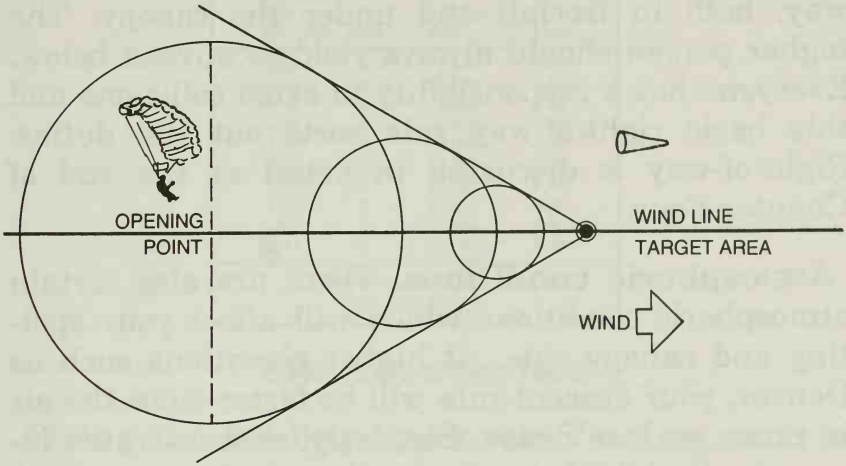
Wind line verification. After opening, turn and face the target. If you are on the wind line, the target will appear to be moving toward you, remaining stationary or moving away from you. If it is moving toward you, turn and hold so as not to overshoot it. While holding, make slight turns so you can watch the target and its movement. If it moves away from you, turn and run toward it. If the target appears to be moving to one side, you are off the wind line and must crab back to it.

Penetration check. Check the strength of the upper winds by facing into the wind and pulling your toggles to 1/4, 1/2 and 3/4 brakes while looking between your feet at an object on the ground. Try each brake setting for several seconds to settle into a steady flying state. Note the brake setting at which you do not make progress over the ground. If you find you are moving at an angle during your penetration check, you have selected the wrong wind line. Make a corrective turn and try again.



Three dimensional diagram showing wind cone under no-wind conditions (side view).

If the good Lord had wanted man to stay on the ground, he would have given us roots.



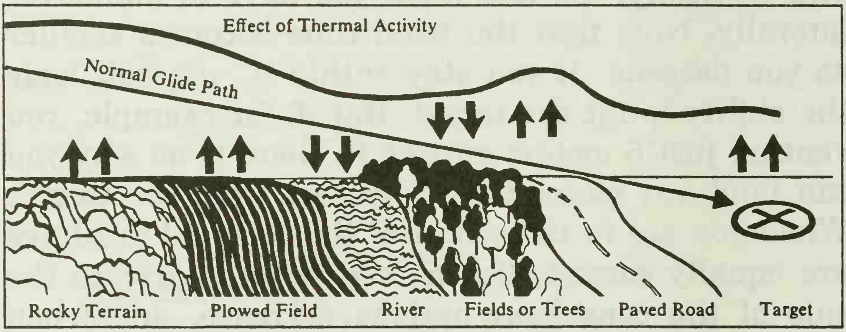
The wind cone with wind added (top view)

The closer you get to the target, both horizontally and vertically, the less room you have to maneuver laterally. Note that the wind cone becomes smaller as you descend. If you stay within it, you will have the ability to hit the target. But if, for example, you venture just 5 meters outside it, there is no way you can land any closer than 5 meters from the target. When you are in the center of the cone, all headings are equally correct. But as you move nearer to the side of the cone your options decrease, and when you reach the edge of the cone, your directional choices are reduced to one.

The principle is simply that if you are *long*, you must use the wind to assist you to cover more ground, and if you are *short*, you must counteract the wind by holding. The ideal spot will permit you to make gentle S-turns astride the wind line. If the target begins to move closer or farther away, you will adjust the concentration of your S-turns accordingly.

Right-of-way. The lower person has the right-of-way, both in freefall and under the canopy. The higher person should always yield to anyone below. Everyone has a responsibility to avoid collisions and this basic right-of-way rule sorts out the duties. Right-of-way is discussed in detail at the end of Chapter Four.

Atmospheric conditions. There are also certain atmospheric conditions which will affect your spotting and canopy ride. At higher elevations such as Denver, your descent rate will be faster since the air is rarer, or less dense. Similarly, descent rates increase when the barometric pressure drops or when the air is humid and/or on hot days.



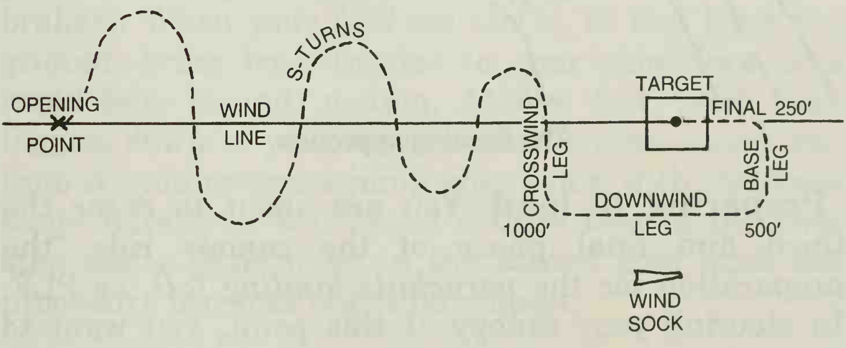
The effect of convection currents on canopy flight

Changes in descent on a single jump may be felt as you cross certain areas such as a forest to a highway. Some areas absorb or give off more of the sun's heat than others. Runways and tin roofs may produce *thermals*, boiling bubbles of warmed air which rise quickly. If you pass through one of these invisible lift machines, you will ascend a bit and your canopy ride may be extended by several minutes.

METERS PER SECOND	MPH	KM per hour	Knots
0.45	1	1.609	0.87
0.89	2	3.219	1.74
1.34	3	4.828	2.61
1.78	4	6.437	3.47
2.23	5	8.046	4.34
2.68	6	9.656	5.21
3.12	7	11.265	6.88
3.57	8	12.874	6.95
4.02	9	14.484	7.82
4.47	10	16.093	8.68
For higher speeds, add the applicable figures.			

Speed Conversion Table

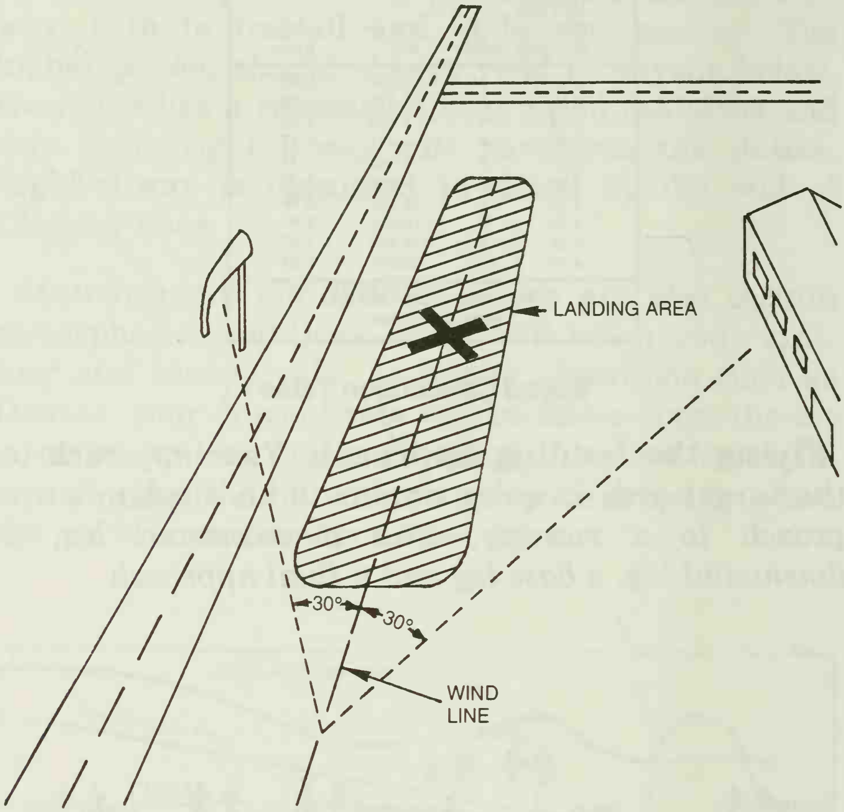
Flying the landing approach. Your approach to the target area is quite similar to an airplane's approach to a runway, with a *crosswind leg*, *a downwind leg*, a *base leg* and a *final approach*.



Flying the pattern

These are the basics of flying the pattern. For more details and tips on very accurate landings, see Chapter Six.

> *The best time to prepare for a landing is before you get into the plane. Observe ground wind speed and direction, and whether it is steady or variable.* - Eric Roberts



The landing approach

Preparing to land. You are about to enter the third and final phase of the canopy ride, the preparation for the *parachute landing fall*, or PLF. In steering your canopy at this point, you want to concentrate on two areas. First, you want your canopy headed directly into the wind when you land to minimize your *ground speed*—your horizontal movement over the ground. So you will face the opening point, upwind of the target, and check the wind sock to see if there have been any minor changes in the lower or *ground* winds. Secondly, during the last 200 feet and 20 seconds, you want to avoid all but very minor corrective turns to the canopy (no

more than 30 degrees to either side) since a large turn will only increase your horizontal travel by swinging you out from under the canopy. And, let's not forget that canopy descent increases during turns. So, land with a stable canopy, landing as slowly as possible. Now here you are at 200 feet positioned over the drop zone in the vicinity (just downwind) of the target and preparing to land. Your toggles should be up for full glide. Caution: Feeling wind in your face doesn't indicate you are *faced into the wind*. You will always feel wind in your face because the canopy is moving forward through the air.

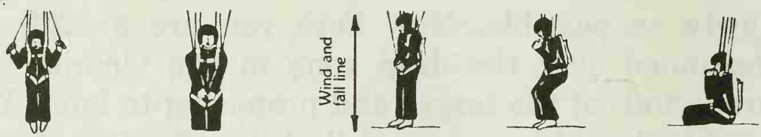
Touchdown technique. Your challenge in landing is to convert the energy in your high forward speed into temporary lift by pulling down on your toggles at precisely the right time. The secret is the *two-stage flare*. Normally, this is done by making your final approach with the toggles full-up (zero brakes). When your feet are ten to 15 feet from the ground, bring both toggles to your shoulders in a rapid (one second) motion. At five feet, push both toggles down to your waist with the same rapid motion. As you progress jump after jump with this two-stage flare, you will brake a little less in the first step and a little more in the second step until the procedure becomes one fluid motion.

You will find that in high winds, it takes less time and altitude to flare. In winds over 20 mph., fly at one-quarter brakes to combat turbulence and flare at three to four feet. If the winds are light, say three to five mph., flare at six to eight feet. These figures are approximate and depend on your *exit weight* and type of canopy. If you have problems, go back to the two-stage flared landing.

PARACHUTE LANDING FALLS

You may not fall down when landing under a main canopy. However, PLF's should be practiced for reserve landings. Use this outline to refresh your memory as you practice from a 4' height. Remember, there is some horizontal flight in addition to the vertical descent. Practice falls to the front, side and rear until they become automatic.

A. PREPARE TO LAND (at about 200' over clear ground): Check for obstacles. Face into the wind to minimize horizontal drift. Hand on steering toggles making slight corrections. Remember, all points of contact should be along the wind (fall) line.



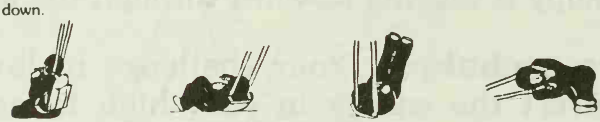
Approach at half brakes, toggles to chest. Feet & knees together, knees bent slightly, toes extended downward, leg muscles tensed, elbows in, look down.

Flare at 5', push both toggles down to crotch. If you fall down or if you are under a reserve:

B. GROUND CONTACT
Toes. Leg muscles tensed and prepared to absorb ninety percent of the impact force.

Rotate body in the direction of fall allowing the knees to move in the direction of force. Head down.

Calf. Elbows and hands forward in front of chest and face.



Thigh. Keep the elbows in.

Butt. Continue roll in one long smooth continuous motion.

Shoulder. First one . . . and then on through to the other.

Feet over, contacting with the line of fall (wind line.)

C. FOLLOW THROUGH
Stand up and run around the canopy to dump its air and deflate it. If you are being dragged and cannot get up, roll over on your back and pull down all the way on one toggle.

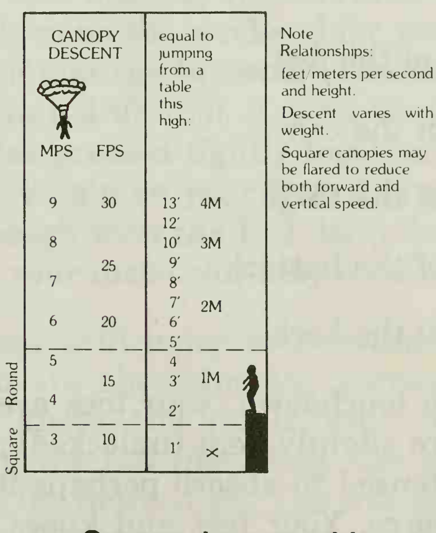
The parachute landing fall

Parachute landing fall. A PLF is a method of falling down on landing which translates the vertical energy, which can smart, into a rotational energy, which won't, without placing any breakable bony part of your body on the ground until the process is successfully completed. In some landings, there is a lot of energy which must be absorbed, so spread it around while protecting the body areas subject to breaking. The drawings above show a forward-left PLF, the most common. Your drift may dictate that it be to the back or to the side but the principle is the same: to distribute the landing force over as much of the body as possible.

It is the jumper's responsibility to continually estimate the probable landing point and make appropriate adjustments to land in a clear area.

If the wind is low-to-moderate and you are faced directly into it when you flare the canopy at the correct moment, you will land so softly that you may not fall over. *Stand-up landings* avoid bruises, keep your jumpsuit clean and make you look great to spectators.

It is a good idea to know how to make good PLF's for those jumps when you land in higher or lower winds, are off the drop zone, find yourself under a round reserve or blow the timing on the landing flare. Practice PLFs to the front, each side and to the rear from a four-foot height until they become automatic.



Canopy descent table

All landings should be made facing into the wind unless it is necessary to take evasive action to avoid obstacles.

One second is about all it takes to make the parachute landing fall, not much time to think about or change your landing plans. The impact is about what you would encounter from jumping off a four-foot platform. But there is some horizontal movement so it is more like jumping off the bumper of a truck doing three mph. Actually, PLFs are easier with some drift than when coming straight down. On contact, you will execute your PLF in the direction of drift, and it may be in any direction, forward, backward, to one side or the other. You will practice landings from a low platform. For more details on descent rates, see the Equipment Chapter.

Think about parachute landing falls in three parts: the vertical force absorption, the horizontal force absorption and getting back on your feet. The points of contact are:

1. The balls of the feet

2. The side of the calf

3. The side of the thigh

4. The side of the buttock

5. The side of the back.

Just prior to touchdown, your toes are bent down, your knees are slightly bent (unlocked) and your leg muscles are tensed to absorb perhaps 90 percent of the vertical force. Your feet and knees are pressed firmly together so that you will be able to roll. You are looking down at 45 degrees, not away from the ground and not directly at it. At this angle, you can better judge your altitude. Your hands are on the

toggles, so now you bring your elbows almost together in front of your face and prepare to flare the canopy. Tuck your head forward and down to avoid whiplash in the case of a backward landing. Watch the ground at 45 degrees in order to anticipate it and begin your roll, noting the direction of drift so that you will roll with it.

Your knees are bent but tensioned to accept the vertical force. You are protecting your breakable elbows by bringing them together in front of you. You touch the ground absorbing most of the shock in your leg muscles. Limp leg muscles are probably the primary cause of injuries on landing. If you have good leg muscle tension, with your legs firmly together and knees unlocked, you are unlikely to be hurt on landing. Practice and discipline yourself! If your legs are limp, you will wind up with a bruised hip and will find walking difficult until just before it is time to return on the weekend for your next jump. You may even manage to remain standing if there is little horizontal drift, but it isn't likely with your feet and knees pressed tightly together. Even if you feel you can remain on your feet, it is a good idea to continue through with the PLF both for the practice and because your instructor may require it.

There is some drift today so it is time to take care of it. As you are absorbing the vertical force, shift the pressed knees and rotate your shoulders and trunk toward the *fall line*. Keep the elbows, hands and head in; let yourself go. You will roll like a ball. Continue on through and spring back up on your feet. Try practicing the vertical and horizontal parts of the landing separately and then use a platform to

go through the whole PLF. Jump, absorb forces in the legs, roll and stand up.

There is a lot to remember and it will be difficult to select and execute the proper PLF for each line of drift, and to decide which way to shift and rotate. You will also find that PLFs use new muscles, so do not be surprised if you have trouble getting out of bed the next day.

Knowing some of the common mistakes may help you to avoid them. Some students anticipate the ground and begin their landing roll before they reach it by retracting their legs; the vertical forces are usually absorbed by the butt. Some put their legs out in front of them, and some go entirely limp. All three produce bruises and occasionally a break. Backing-up landings sometimes result in feet-butt-head ground contact which is to be avoided. If you find yourself backing up in strong winds, turn the canopy as much as 45 degrees from the wind line so you will be able to make a PLF. Similarly, if the wind is very light and you are moving forward on touchdown because you failed to flare the canopy enough, you will want to turn slightly again. This will permit you to do a PLF rather than a FHF (feet, hands, face). Some canopies have slight built-in turns, and all canopies suffer occasionally from turns when the bag and pilot chute hang up. Keep the toggles in your hands. If your knees are not firmly pressed together, you will tend to sit down on touchdown, absorbing the force in the wrong area. That may be your last sitting for a while.

Never land in a turn. A low turn is much more harmful than a downwind landing.

Landing hazards. Some landings can be potentially extremely hazardous, such as descending into water, power lines or trees. If any of these dangers exist in the area of your drop zone, your instructor will make special reference to them and will outline a particular corrective action. We will cover these hazards and others in detail in the chapter on emergency procedures.

Dragging. Your PLF should lead into an immediate recovery in order to avoid being dragged by the wind or covered by the deflating canopy. And you will want to get right back up on your feet for another reason: You want to show the staff that you are OK. Some students are so overcome by their recent jumping accomplishment that they just want to lie on the ground, relax and think about it. That is one sure way to draw a concerned crowd.

You have just flared for the landing. Now as soon as your toes touch the ground, keep one toggle depressed and let go of the other one. If your landing was a stand-up, pivot 180 degrees to the side of the depressed toggle. If you made a PLF, get up. The canopy should rotate and dive into the ground. Now run around the canopy. Think about these landing techniques and practice them on the ground. Plan to use these landing techniques on every jump. If you happen to have a no-wind day, the canopy will deflate without your assistance but it may fall all around you in a tangled mess. If you are quick in following through on your PLF and get up on your feet, you will be able to run out from under it, keeping the lines tensioned and straight. If you are in the target area, you should pull the canopy off to one side to uncover the disc for the next jumper.

There are five basic ways to spill the air from an inflated canopy:

1. Get up and run around either side of it to turn the canopy out of the wind.

2. Pull down all the way on a steering line to rotate the canopy and drive it into the ground.

3. Have a buddy grab an edge and pull the canopy around.

4. Grab the riser and then the lines closest to the ground and pull them toward you hand over hand.

Or

5. Jettison the canopy by pulling the breakaway handle.

Normally, you will simply follow through with your PLF by rolling, recovering and running around your canopy. If you find yourself being dragged and unable to stand up, pulling all the way down on one toggle should take care of the canopy. Choice number five is a last ditch method and it is doubtful that you will experience winds strong enough to need it. Jettisoning a riser will make a tangled mess of the canopy, and in high winds the riser will take off like a shot from a sling, so don't attempt it on a crowded DZ. With some parachute systems, jettisoning the risers also releases the reserve canopy.

The most important thing to remember in your recovery is to act quickly. A gentle dragging across the DZ can begin as an entertaining ride and quickly turn into a high speed, dangerous situation where you are not in complete control.

Skydiving is a world-wide fraternity

Camaraderie. After you land, other jumpers will probably come over, pump your hand and welcome you to the great world-wide fraternity of parachuting. They know your excitement and both want to encourage it and join you in your moment of glory.

Field packing. Now comes the field care of your parachute, or preparing it for transport back to the packing area. Stick the toggles to their Velcro strips on the risers. Then work the slider up as you coil the lines and grasp them firmly in one hand. Grab the canopy by the lines adjacent to the canopy and sling the canopy over your shoulder. If you are short, or have a large canopy, pick it up in your arms. Do not let the canopy drag on the ground.

Jumpers who land a great distance from the drop zone often pack their main on the spot before hiking back.

Sling the canopy over your shoulder.

Debrief. Next it is time for the jump debriefing or *after-jump critique* from your jumpmaster, who has only recently arrived on the target. If you are to learn from your experience and improve upon the last jump, you must solicit an objective observation of your performance. The jumpmaster will check with the ground crew on your canopy work, and he may debrief all the students at one time. This is to your advantage as you will learn from the experiences of others. First, he will probably ask you what you did. This helps you to remember; he wants to know what you think and how you interpret your own performance. Then he will tell you what he and the ground crew saw so you can re-evaluate your impressions with this new information. He will prescribe some corrective ground practice and will tell you what to concentrate on during the next jump.

The First Jump Certificate

Log book. The jump will be recorded in your log book, criticisms and all, in order to maintain a continuing record of your parachuting progress. This is for your reference, the jumpmaster's benefit and for any other jumpmasters you may have on future jumps. This log will be with you forever so learn how to fill it out (keep it neat) before you take pen in hand.

Packing. If you are jumping with a club, you will probably venture to the packing area next to repack your parachute. If this is a commercial center, they will do it for you and you are free to sign up for jump number two.

The next jump. Many, many students make two jumps the first day. Incidentally, Richard Bach, the

author of *Jonathan Livingston Seagull*, made seven jumps, including two freefalls, his first day out. But jumping, especially all the preparation, is tiring and you will probably be limited to three jumps per day initially. If you hustle, you can be on freefall by next weekend!

You've done it! It's been a long day and you have accomplished and learned so much. You have a greater appreciation for the air, aviation, weather and especially yourself. You notice the wind, its direction and velocity. Weather no longer provides *nice days* and *lousy days*, now they are *jumpable* or *terrible*. You begin to look up and you notice many things you have never seen before. Canopy nylon has a great aroma all its own. And you have a warm feeling of new-found confidence. After all, anyone can jump, but few people will. You did it and you are proud. You have conquered another fear, that of falling. It's just like when you learned to swim, only better.

Your instruction does not end with your first jump. You will be carefully supervised until you acquire your first license. Then the challenges change but the learning continues as you work on your skydiving proficiency. Always remember to ask your instructor about any techniques that are not clear to you.

You know it is Spring when the four feet of snow which covered the runway making it impossible to jump, have melted to one foot of mud, making it impossible to jump. - The Spotter Newsmagazine.

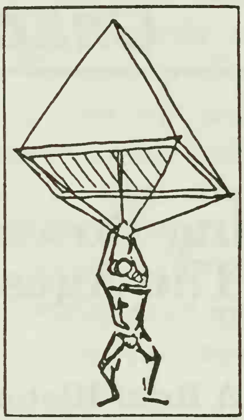
Chapter Three

Parachuting Down Through The Ages

A Brief History

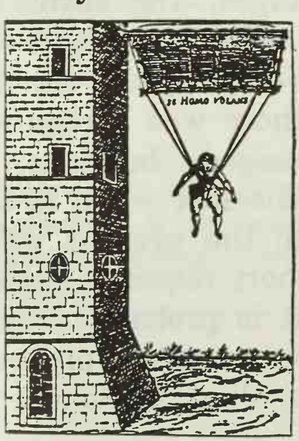
During the last ten centuries, parachutes and skydiving have passed through three basic developmental stages. The earliest occurred before the balloon and other aircraft, before there was an actual need. The second was during the last three centuries when there was a requirement to be able to escape damaged balloons, airplanes and spacecraft. And the last stage is taking place from the late 1950s to the present within the sport of skydiving. The sport requires significantly different equipment and it is probably true that since 1960 there have been more improvements to the parachute than in all of previously recorded history.

1100s. There is evidence the Chinese amused themselves by jumping from high places with rigid umbrella-like structures. Early accounts are impossible to verify due to the lack of recorded data and it should be noted that most parachutes were one of a kind; there was no standardization until World War I. Further, after careful study, one suspects that many of these early pioneers confused vertical descent with horizontal flight. They probably wished to emulate the birds, not the down of a thistle.



da Vinci's parachute

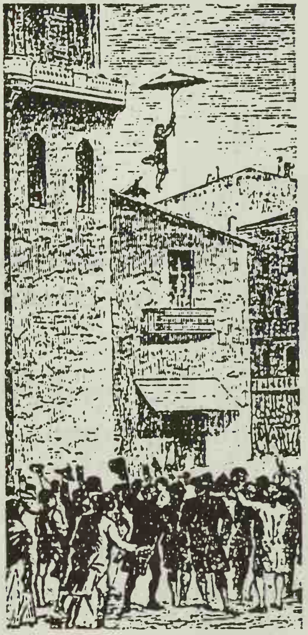
1495. Leonardo da Vinci's parachute was pyramid shaped and was held open by four wooden poles. There is no evidence that he constructed any working models; he left only a sketch.



Veranzio's parachute

1595. Fausto Veranzio's parachute consisted of a square wooden frame covered with canvas and it is claimed he jumped from a tower in Venice in either 1595 or 1617.

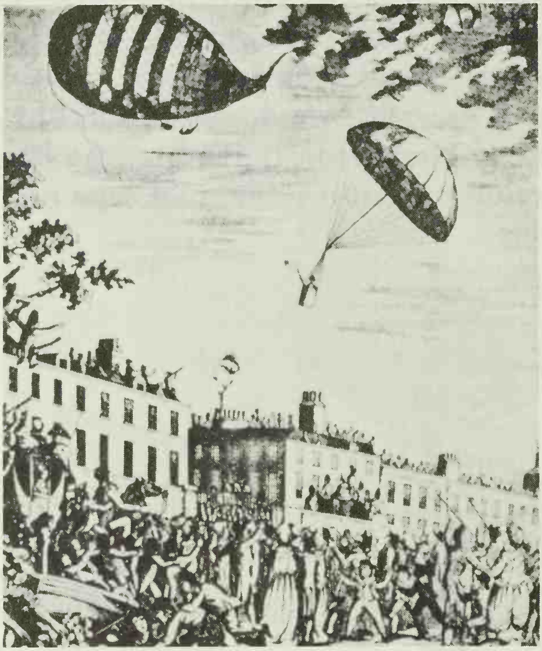
1687. One of the earliest written accounts of parachuting comes from Siam. According to the French envoy, one of the king's tumblers would jump from high places with two large umbrellas. The launch point must have been quite high as the wind sometimes carried him into trees, roof tops and occasionally the river.



Lenormand jumps from a rooftop in Montpelier, France

1783. Sebastian Lenormand jumped from a tower with a 14 foot diameter parachute hoping to perfect a way to escape burning buildings. The Montgolfier brothers made their first balloon flight. Later, the Montgolfier brothers tested various parachute designs. In one experiment, a sheep was safely lowered on a seven foot canopy.

1785. J. P. Blanchard devised the collapsible silk parachute. Prior to this all canopies had been held open by a rigid framework. There is some evidence that he jumped from a balloon in 1793, and he did break a leg about this time.



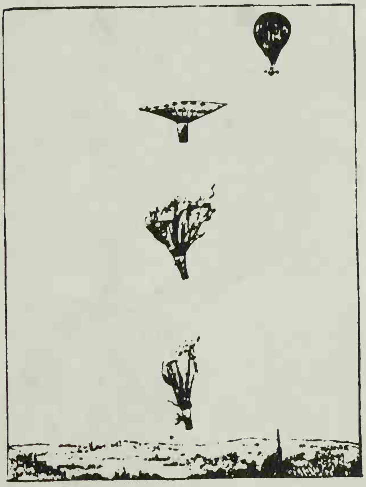
Garnerin descends over London in 1802

1797. Andre Jacques Garnerin gets credit for being the first real parachutist because he made so many jumps, beginning with one from 600M (2,000 feet) over Paris. In 1802 he made a jump from 8,000 feet over London with a silk canopy some 23 feet in diameter. It oscillated terribly, making him airsick.

1804. A Frenchman named Bourget jumped with a collapsible canopy. Lelandes, a French astronomer, added a vent to his canopy to reduce the oscillations and it worked.

1808. A Polish balloonist named Jodaki Kuparento made the first emergency jump when his balloon caught fire over Warsaw.

Early 1800s. Sir George Cayley, an English aviation pioneer, was the first to propose an inverted cone canopy. His was very unstable. This design is being investigated again today. Lorenz Hengler, a German, made several jumps from a balloon at 30 to 120 meters.



Robert Cocking, the first parachuting fatality

1837. Robert Cocking released his inverted cone parachute over Lea Green in England and fell to his death when it collapsed. It was 107 feet in circumference and weighed over 200 lbs. The release was on the balloon, not the canopy, and it is supposed that he may have wrapped the release line around his wrist to obtain a better grip. This would have jerked him upward into the cone, breaking it.

1838. John Wise twice permitted his balloon to explode at 13,000 feet over the U.S. Each time the underside of the envelope inverted assuming a parachute shape and lowering him safely.

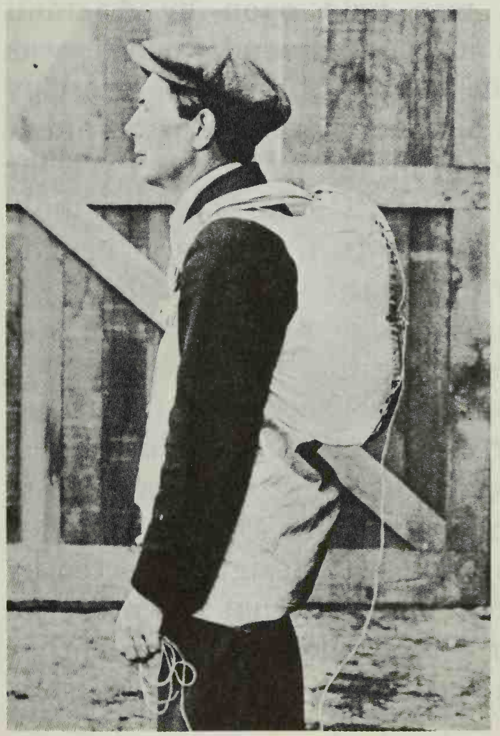
1887. Captain Tom Baldwin invented the harness in the U.S. He would ride up in the balloon, sitting

on a trapeze bar. The apex of the silk canopy was tied to the trapeze. When ready to jump, he would simply slip off. He dispensed with the basket entirely.

Kathe Paulus was the first German professional parachutist. The *folded exhibition attached type* was used by many of the early jumpers. Here the suspension lines were attached to a concentration ring made of wood with a tennis racket-like mesh. The lines were coiled on the mesh and the canopy was accordion-folded on the lines. Two perpendicular tie ropes secured the canopy to the ring. A ring knife was used to release the canopy and there was a breakcord from the apex of the canopy to the balloon.

1890. Paul Letteman and Kathe Paulus are credited with being the first to use the *remote automatic sack type* parachute; the design is still used for cargo drops today. The apex of the canopy is tied to the inside of the canvas bag with breakcord. The canopy and lines are then folded into the bag and the mouth is tied closed with breakcord. The risers lead out to the load and the bag is affixed to the balloon or airplane.

Mike Blodgett models a variation of the pack on the aircraft type parachute. The container is fitted with a Ford steering wheel and is laced together with string. Two thin leather leg straps are missing from the model. Newspaper is packed between the folds of the canopy and loops of line.



The Broadwick Coatpack

1901. Charles Broadwick designed the *pack on the aviator* type parachute. His *coatpack* was laced

together with breakcord. A static line broke the lacing and pulled out the canopy.

1903. The Wright brothers made the first powered flight and parachute development picked up speed.

1908. A. Leo Stevens invents the ripcord in New York. Georgia Thompson (Tiny) Broadwick begins her 1,100 jump career by parachuting from a balloon over Raleigh, North Carolina. She used the parachutes designed by her foster father, Charles Broadwick.

1911. An Italian named Joseph Pino gets credit for designing the pilot chute. He mounted it on an aviator's cap and it was held open by a small framework. When he jumped, the pilot chute was supposed to remove the helmet and pull the canopy from the *knapsack* on his back. Grant Morton didn't use any pack at all when he jumped from a Wright Model B aircraft over Venice, California. He simply rolled and folded the canopy in his arms. When he jumped, he just threw it into the air. While this was the first non-static-line jump, it may not be the first freefall jump; there is a question of interpretation. S. L. Van Meter of Lexington, Kentucky, filed for a patent on a *soaring type parachute*. A pilot in distress could pull a ripcord releasing the canopy into the air and it would pull him free of the aircraft. G. E. Kotelnikov had his parachute designs rejected by the Russian government; they felt that the presence of a parachute would tempt pilots to jump rather than attempt to save the aircraft.

1912. When Captain Albert Berry made his jump from an aircraft over Jefferson Barracks, Missouri, his parachute was packed in a metal cylinder at-

tached to the underside of the plane over the axle. He just climbed down to the axle, slipped into the harness and jumped. As he fell away, his weight pulled the canopy from the container. About this same time, M. Hervieu was making dummy drops from the Eiffel Tower. M. Bonnet successfully lowered an airplane fuselage with a dummy from a balloon over France. Frederick Law made a jump from the Statue of Liberty.

1913. M. Adolphe Pegoud successfully tested a soaring type parachute over Chateaufort, France. Captain M. Douade designed a canopy for lowering entire aircraft but World War I canceled his development plans.

Tiny Broadwick is credited with many parachuting firsts

Tiny Broadwick became the first woman to jump from an *airplane* when Glenn Martin took her aloft over Los Angeles. Later that year she became the first woman to make a water jump when she parachuted from a hydroplane into Lake Michigan.

The gull sees farthest who flies highest. - Richard Bach

1914. Tiny Broadwick was demonstrating the parachute to the Army in San Diego when, on her fourth jump, the static line caught briefly on the tail section of the Martin Trainer. Fearful it might happen again, she cut the line. On the last demonstration jump, she pulled it herself and made history: the first jump on a *manually-operated* parachute.

1917. Most nations adopted parachutes for use in balloons (there was no time to evaluate the situation once the hydrogen-filled balloon was hit by enemy fire) and airplanes, as the aerial portion of World War I heated up. All parachutes, operated on the static-line principle, were too heavy and much too weak. Juseke Fuji of Stanton, New Mexico, filed a patent on a manually operated parachute. And late in the year, J. Floyd Smith wore a manually operated parachute of his own design while flying.

The Smith Aerial Life Pack was the first of the modern manually operated parachutes

1918. Floyd Smith filed for a patent on his manually operated parachute.

1919. Leslie Irvin developed a static-line-operated parachute and filed for a patent.

The Army set up a parachute design center at McCook Field in Dayton and staffed it with Floyd Smith and Major E. L. Hoffman. On April 28th, Leslie Irvin made a freefall jump to test the product as Floyd Smith piloted the plane. The manually operated parachute was basically the same one that Smith had designed earlier. Irvin immediately formed *Irving Air Chutes* and built the first 300 units for the Army. A rushed typist mistakenly added the "g" to Irvin and the company kept it for some 50 years. The McCook Field team consisted of Hoffman, Smith, Irvin, Guy M. Ball, "Jimmy" M. Russell, J. J. Higgins, and Sgt. Ralph W,. Bottreil. Most remained in the parachute field and were responsible for virtually all of the parachute development over the next 30 years.

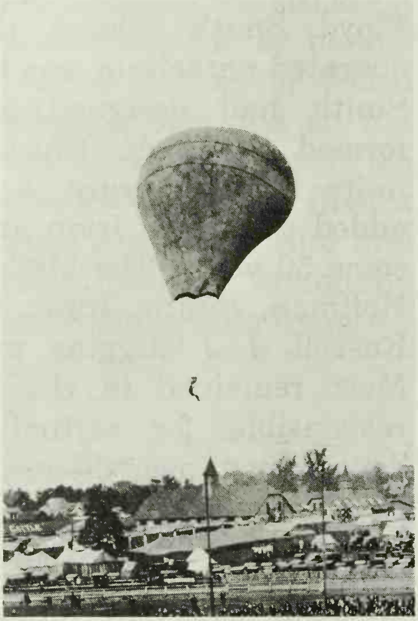
1922. Lt. Harold R. Harris became the first to make an emergency freefall jump from a disabled airplane. He had difficulty locating the ripcord handle and freefell some 2,000 feet. It is interesting to contrast this jump with all those made in World War I; they were all static lined. One month later, the Caterpillar Club was established. Those who were saved by parachute were awarded a small gold (silk spinning) caterpillar pin.

1924. The parachute rigging school was opened at the Naval Air Station at Lakehurst, New Jersey.

1925. Steven Budreau, an Army instructor, made a jump from 7,000 feet and freefell to 3,500 feet over Selfridge Field, Michigan. He proved that the body could fall in a stable position and not go out of control.

1926. Charles Lindbergh makes his fourth emergency jump. Later that same year, James Clark made the first camera jump.

From the infield of the racetrack of the fair grounds at Rochester, N.H., Charles Dame goes aloft for a triple parachute jump. The three parachute packs are visible just above his head. (September 1927)



1927. Charles Lindbergh made the first transatlantic solo flight. This was also the year that Security Parachute Co. was established as Johnny's Parachute Loft at the Oakland Airport, and the Switlik Company began making parachutes in Trenton, New Jersey.

1928. General Billy Mitchell had six military men jump from a Martin bomber at Kelly Field, Texas, and set up a machine gun. This was the first demonstration of the usefulness of paratroops.

1929. E. L. Hoffman filed for a patent on his triangular shaped canopy. The quick release box was patented in Great Britain thus making a single point release harness possible.

1930. The Russians stage the first parachute meet at the Sports Festival. Amateurs competed to see who could land nearest a specified target.

1932. Forty parachutists competed at the National Air Races at Roosevelt Field, New York. The organizational work is credited to Joe Crane who persuaded the National Aeronautic Association to formally sanction sport parachuting competitions. Later he formed the National Parachute Jumpers Association, a predecessor of the USPA.

1933. The Russians unified all sport parachute clubs into a national organization. Later they staged the first mass drop when 62 parachutists jumped from three bombers. This was also the year Wiley Post made the first solo flight around the world.

1934. Floyd Smith published a magazine article describing freefall techniques for delayed jumps. The Forest Service experimented with the dropping of fire fighters to battle forest fires. Later the *Smoke Jumpers* were established. American Victor Herman set an altitude record jumping from 24,000 feet in the Soviet Union.

1935. The first free-drop parachute tower, some 125 feet high, was built in Hightstown, New Jersey. And this was the year that the infamous DC-3 made its first flight.

1936. By this time, the Russians had established 559 training towers and 115 training stations. In

the U.S. during the late '30s, there were some steerable canopies such as the Hoffman Triangle and the Hart designs. But designers turned back to the non-steerable models in the '40s. Colonel Wateau of France proposed the FAI accept parachuting as a sport.

1937. The first flight of the Twin Beech. This aircraft was to be used extensively for parachuting in the 1960s and lead to the formation of ten-person teams, the number of skydivers it would hold.

1938. Floyd Smith and Lyman Ford approach Henry R. Mallory at the 100 year old Cheney Brothers Mills in Manchester, Connecticut, proposing to form a parachute company. Pioneer Parachute Co. was established and Smith designed a completely new line of parachutes. World War II was not far off. Nylon is invented by duPont.

1941. The Germans dropped 14,000 paratroops onto the island of Crete. In the U.S., Arthur H. Starnes made a record freefall from 30,800 feet to 1,500 feet. Carefully monitored by doctors, he proved that properly equipped aviators could survive long delays from high altitudes. December 7th: The Japanese attack Pearl Harbor and the supply of silk to the U.S. parachute industry is shut off.

1944. Frank Derry applied his *Derry Slots* to some 28 foot military reject canopies to bolster the dwindling Forest Service inventory. This was a significant action, as he was modifying surplus canopies for steerability for the first time.

1946. The National Parachute Jumpers Association changed its name to the National Parachute Jumpers-Riggers, Inc.

1947. Charles E. Yeager made the first supersonic flight over the United States. More improvements in the parachute would be needed.

1948. At the prompting of Joe Crane, the NAA proposed to the Federation Aeronautique Internationale, the international body which governs sport aviation competition and records, that parachuting be accepted. The Commission Internationale de Parachutisme was established and Crane was appointed the first U.S. delegate. Leo "Birdman" Valentin developed the spread, face-to-earth freefall position and later the method of using the arms and legs to make controlled turns and barrel rolls. He was killed in 1956 while using large plywood wings to extend his freefall time. One wing hit the plane on exit and broke, placing him in a spin. He activated both parachutes but they tangled around him. By now, the Italians had established 48 local parachute clubs.

1949. The French government set up ten public sport parachuting centers. The techniques of stabilized freefall were further refined.

1950. Captain Richard V. Wheeler bails out at a record 42,449 feet. The first meeting of the Commission Internationale de Parachutisme of the FAI was held in Paris.

1951. Five European nations fielded teams to the First World Parachuting Championships in Yugoslavia. The CIP adopts world record classifications.

1952. Lew Sanborn was issued parachuting license A-1, A. R. Garrison B-1 and Joe Crane C-1.

1954. Fred Mason, an Army sergeant stationed in Europe, represented the U.S. at the Second World Parachuting Championships at St. Yan, France. Eight nations were represented. Richard Hart filed a patent on an extended "T" cut in standard flat circular canopies.

1955. Jacques Andre Istel visited France, learned the freefall techniques and returned home to form the first U.S. parachute team. Raymond Young coins the term *skydiving*.

1956. The first U.S. Team was fielded for the Third World Championships in Moscow, using borrowed equipment. They finished sixth out of the ten nations entered.

1957. The NPJ-R evolved into the Parachute Club of America. Jacques Istel and Lew Sanborn filed for a patent on the deployment sleeve.

1958. Lyle Hoffman and James Pearson of the Seattle Skydivers made the first baton pass in Vancouver, B.C. A month later, Steve Snyder and Charlie Hillard made the first in the U.S. at Fort Bragg, North Carolina. This was the year that the Army reversed its stand against sport parachuting and actually began to foster and encourage it. Military parachute clubs blossomed nationwide overnight. The U.S. Team was picked at an elimination meet for the first time and the winners went on to compete at the Fourth W.P.C. in Bratislava, Czechoslovakia. The U.S. finished sixth out of 14. Jacques

Istel files for a patent on the *three panel T* and *double blank* steerable canopy modifications.

1959. Lew Sanborn issued license D-1. The Strategic Army Corps Parachute Team was formed in Fort Bragg. Two years later they were renamed the Army Parachute Team and soon after they adopted the nickname *Golden Knights*. Dave Burt developed the para-scuba concept. Jacques Istel's Parachutes Incorporated opened the first commercial sport parachuting center in the U.S. in Orange, Massachusetts. In the late '50s, the sport of parachuting began to grow and equipment played a large part in this development. The sleeve, introduced from France, made opening forces tolerable, and military surplus parachutes were cheap. With a little work, a 28' Air Force back parachute could be made steerable, a sleeve could be added and D rings for the reserve attachment could be installed. At the urging of Parachutes Incorporated, Pioneer began to manufacture a line of sport equipment. Steve Snyder began work on an automatic parachute activating device designed to meet the particular requirements of the sport parachutist. He incorporated as *Steve Snyder Enterprises* and filed for a patent on the *Sentinel* the following the year.

Kittinger reached 702 mph in his plunge from 102,000 feet

1960. Captain Joseph W. Kittinger, Jr. stepped out of a balloon gondola at 102,000 feet over New Mexico with only a 6' stabilizing chute. During the freefall to 18,000 feet, he reached a terminal velocity of 702 mph.; the trip took four and a half minutes. Curt Hughes and Loy Brydon patented the famous TU steerable canopy modification. The Army parachutists swept the U.S. Team tryouts and competed in Sofia, Bulgaria. Barbara Gray of North Carolina and Sherrie Buck of California were the first female entries from the U.S.

1961. Ted Strong, coach of the West Point Parachute Team, returned to civilian life and established a parachute company in the Boston area. This was the year that the National Collegiate Parachuting League was established. In Arizona, four employees of Parachutes Incorporated, Jacques Istel, Lew Sanborn, Nate Pond and Bill Jolly, established two world records, the first for the U.S. Pierre Lemoigne filed his basic Para-Sail/Para-Commander patent.

1962. The first PCA Instructor/Examiner Conference was held in Phoenix and 19 candidates took part. PCA membership was beginning to climb and had already reached 6,000. The U.S. hosted the 6th World Championships at Orange, Massachusetts; 24 nations were represented. For the first time, the U.S. fielded a full women's team. After the meet, some northeast parachutists tried sleeving and jumping Lemoigne's Para-Sail. With the addition of some steering lines, Pioneer developed it into the Para-Commander. It was demonstrated at the 1963 Nationals in Issaquah, Washington, but conservative Pioneer was reluctant to market it.

1963. A combined Army and Air Force team bettered the Soviet Union's group altitude record of 37,000' when they exited a C-130 at 43,500' over El Centro, California. The Federal Aviation Administration published the first formal rules for sport parachuting, thus recognizing the establishment of the activity. Lemoigne filed for another patent on the Para-Commander concept.

1964. Domina Jalbert of Boca Raton, Florida, filed for a patent on his ram-air inflated Para-Foil canopy. In the early part of the year, Loy Brydon helped Security develop the Crossbow (XBO) parachute system; the first sport piggyback, it was revolutionary. The canopy resembled the Para-Commander and its availability forced Pioneer to the market. The U.S. Team chose to use the PC in the XBO system and in 1964 they dazzled the World at the 7th W.P.C. in Leutkirch, West Germany. Six years after the first baton pass, six jumpers piled out of two aircraft over Arvin, California, and formed the first six man star. Bob Buquor caught it all on film. This was the year the Chute Shop (later North American Aerodynamics) was established in Flemington, New Jersey. The Army Parachute Team made an assault on the world records and conquered 55% of them. This was the first time that any one nation had held a majority of parachute records.

1965. The Arvin Good Guys formed the first eight man star. This year will also be well remembered for another reason. It was the time the commercial airline industry ganged up on the sport by encouraging the FAA to enact very restrictive regulations. Jumpers united under PCA and argued their case by writing letters and attending the hearing. The

parachutists put up such an impressive show, the Air Transport Association and others didn't even bother to show up for the rebuttal session in the afternoon. Rod Pack made the first chuteless jump.

1967. The Parachute Club of America is renamed the United States Parachute Association. The first ten man star was completed over Taft, California. A week later it was duplicated over Elsinore. Then six months later a ten man star competition was staged. In the '60s, most jumpers used non-steerable reserves in the belief that an unmodified canopy opened more reliably. Steerable modifications to reserve canopies hadn't been approved by the FAA and few people had them. Actually few were known until the reserve was used. Toward the end of the decade, some lofts acquired approval for single or multiple *dog houses*. Bill Newell founds the Bob Buquor Memorial Star Crest.

1968. Steve Snyder performed developmental work on the ParaWing and filed for a patent on his OSI or *Opening Shock Inhibitor*, a heavy web strap which wrapped around the lines.

Johnny Carson receives his final equipment check prior to his first jump, a freefall from 12,500 feet

The sport received a great deal of publicity that year when Bob Sinclair took Johnny Carson out at 12,500 on a buddy jump. Sinclair held the entertainer's harness until he pulled his ripcord. The videotape was shown on the *Tonight Show*. Strong Enterprises developed the Stylemaster harness/container system for the U.S. Team. It incorporated a number of revolutionary design features.

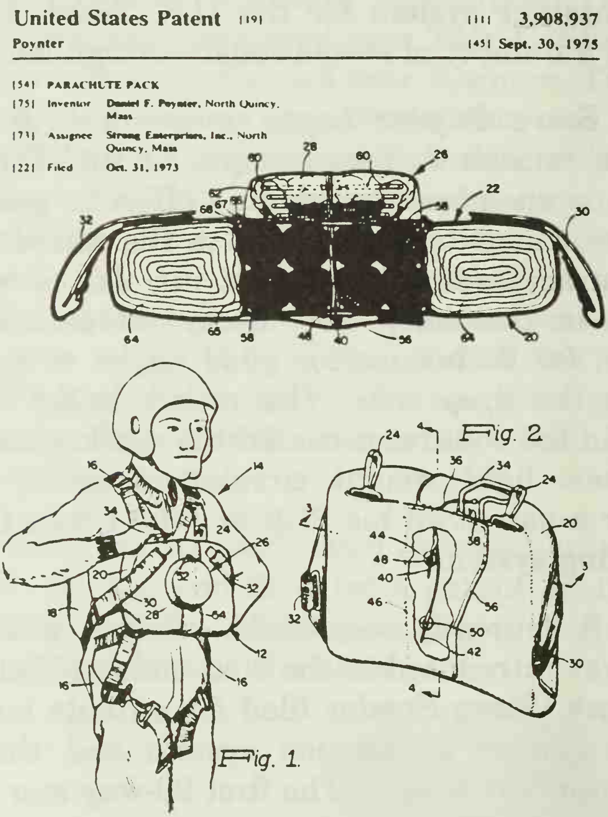
1969. Steve Snyder began to market the Para-Plane, a ram-air Jalbert canopy. He and Dick Morgan made an intense marketing effort to prove that a square canopy was superior to the round one for the accuracy event. As interest in relative work increased in the early '70s, many jumpers selected squares, for their superior glide angle, to get them back to the drop zone. The round, bulky PC was dead and the squares cornered the market except for some new light weight circular canopies. Snyder filed for a patent on his PCR or *Pilot Chute Controlled* reefing system.

1970. A four-way sequential relative work team event was introduced to the Nationals in Plattsburg, New York. Steve Snyder filed for patents on a new ram-air canopy suspension system and the Mark 2000 automatic opener. The first 20-way star is built over Elsinore.

1972. The ten-way event was introduced to the National Championships held in Tahlequah, Oklahoma. The name of the game was speed stars, or forming the circle as soon as possible after exit. Interest developed in the team events and the biggest social event of the winter jumping season was the Thanksgiving meet in Zephyrhills, Florida. The U.S.

hosted the World Championships in Tahlequah, Oklahoma.

1973. The Army Team's DC-3 crashed on the way to a demonstration jump killing all 14 aboard.



1974. A world record 31-way star was formed over Elsinore, California. North American Aerodynamics acquired the rights to the Jalbert Para Foil and began limited production. In the early '70s relative work boomed and buyers demanded parachutes which were smaller and lighter. Smaller meant the last team member would be closer to the door for the speed event. Lighter meant more freefall time,

since all would fall slower and with a greater range of speed. Conventional harness/container systems were developed, such as Strong's Fastback with a sloping top so it wouldn't hang up in the top of the door on exit and the POP TOP reserve which was very thin and clean. But by 1974, the equipment pendulum was swinging again and RW jumpers were returning to the piggyback; its clean lines made the flying better and slowed the fall. Jumpsuits grew bigger and bigger.

1975. A 32-man star was formed over Tahlequah and Snyder's Strato-Cloud went into production. About this time the FAA relaxed its insistence that manufacturers design and build entire parachute systems in order to acquire approval, and this resulted in a great proliferation of small manufacturers producing harness/container assemblies specifically for the sport. Bill Booth eliminated the ripcord on his Wonderhog assembly and substituted a throw-out pilot chute. USPA moved its headquarters from Monterey, California, to Washington, D.C.

1976. The year of the U.S. bicentennial saw a new social event at the Nationals, the *Boogie*. This was a four day affair between major jumping events, filled with non-evaluated jumping, manufacturers' displays, seminars, canoe trips and fun. It was highly successful and promised to be an annual event. Canopy Relative Work was demonstrated at the Nationals. For the first time, every accuracy competitor jumped a square canopy.

1977. Mike Barber and Kirk Morrison make the first tandem jump over DeLand. The large group event was changed from speed stars to sequential,

and team events became infinitely more popular than unaccompanied flight. Manufacturers catered to the relative worker. Ripcords were long ago changed from metal to plastic, the throw-out pilot chute was very popular and many alternatives to the Capewell canopy releases appeared. Never before in the history of the parachute had so many users spent so much developmental effort without governmental financial inspiration. Bill Dause is first to reach 5,000 jumps.

1978. Para-Flite introduces a ram-air reserve canopy. USPA membership continues to climb, the equipment becomes even more exotic and the sport continues its vigorous growth. More jumpers than ever become proficient at sequential relative work, and canopy relative work becomes more popular. Bill Ottley becomes executive director of USPA. Richmond, Indiana, hosted the nationals for the first time and the boogie was the biggest yet. A DC-3 crashed on takeoff but all survived. Para-Flite licenses other firms to manufacture ram-air canopies. FAA extends the reserve repack cycle from 60 to 120 days.

1979. USPA recognizes canopy relative work. BASE jumps are made off El Capitan in Yosemite National Park. Mike Truffer starts a tabloid entitled *Skydiving*. An all-women 24-way formation is made over Elsinore.

1980. Fuel prices climb. Several centers adopt piggyback gear for student use. Skydivers open the Super Bowl. Craig Fronk and friends make the first North Pole jump. USPA adopts rules for Para-ski National Championships. Elsinore is flooded.

1981. The Nationals are held in Muskogee, Oklahoma, for the first time. Relative Work World Championships is hosted by Zephyrhills, Florida. Carl and Jean Boenish start *BASE* magazine covering jumps from fixed objects. A 27-way night formation is made over Perris, California. The USPA approves the Accelerated Freefall Program. Canada initiates a Progressive FreeFall Program similar to the U.S. AFF Program.

1982. Canopy Relative Work becomes part of the Nationals for the first time and a 20-way formation is made. CRW has its first World Cup competition. USPA Headquarters moved to Alexandria, Virginia. Some centers begin using square canopies for student training. *Mr. Bill* jumping began. Twelve skydivers die in a crash of a Twin Beech at Taft, California. U.S. fatalities drop to 29.

1983. Ted Strong and Bill Booth begin experimenting with tandem jumping. The FAA decides not to deregulate sport parachuting. The CSPA makes use of automatic releases by students mandatory. Elsinore was closed by rising waters again. Jump suits get tighter for increased fall rates. A 72-way formation is built over DeLand. The FAA approves the use of auto gas in some aircraft. USPA initiates Eagle and Falcon freefall awards.

1984. USPA introduces the Pro Rating for demonstration jumpers. Frenchman Roch Charmet makes jump number 10,000 in Sheridan, Oregon. The FAA adopts TSO C-23c standards for parachutes. An all-women 48-way formation is completed in DeLand. USPA approves the use of square canopies by students. B.J. Worth jumps off the Eiffel Tower for a James Bond film.

1985. Ted Strong develops a drogue to slow tandem jumpers. John Stanford and Phil Huff experiment with up-skiing: using a round canopy to tow skiers up the hill. A 23-stack canopy formation is built over Spaceland Paracenter in Houston. A 28-way arrowhead canopy formation is built over New Hanover, Pennsylvania. Dave Huber makes 250 jumps in 24 hours in Issaquah, Washington. Bill Dause logs 100 hours of freefall time and 9,000 jumps. Don Kellner makes jump number 10,000 in Hazelton, Pennsylvania. Annual U.S. fatalities drop to 24.

1986. Paul Poppenhager, Jr makes 60 jumps in ten hours, packing his own main. An all-female 60-way formation is built over DeLand. A 100-way formation is built over Muskogee, Oklahoma. Nearly 2,000 turn out for the Freakbrother Convention, renamed the World Skydiving Convention, in Quincy, Illinois, and a 120-way formation is built. The first tandem fatality is recorded in Connecticut. The Olympic Committee recognizes the FAI as the official representative of hang gliding, soaring and parachuting. Warning labels appear on jump gear. Slope soaring with foot-launched ram-air canopies becomes popular in Europe.

1987. The Sentinel automatic activation device is withdrawn from the market by Steve Snyder after 27 years because of product liability considerations. Ram-air canopies are approved for student use in the U.K. Frenchman Roch Charmet makes jump number 13,000 in Sheridan, Oregon. Greg Robertson saves a jumper rendered unconscious, by diving down and pulling her reserve. A 126-way formation is built over Koksije, Belgium. Cheryl Sterns and

Russell Fish each make 255 jumps in a 24-hour period in Lodi, California. USPA receives assurances from major airlines that parachutes will be allowed as carry-on baggage. The DZ at Issaquah, Washington, is closed. New York deregulates skydiving. A 32-way CRW formation is built over Lapalisse, France.

1988. The Parachute Industry Association holds its winter meeting on a cruise ship between Florida and the Bahamas. Skydiving opens the Olympics in Seoul. Dale Nelson makes 301 jumps in less than 24 hours in New Hanover, Pennsylvania. Rocky Kenoyer makes 403 jumps in 24 hours in Snohomish, Washington. USPA changes the BSR's to require ram-air main canopies, automatic activation devices and piggyback containers for students as of January 1, 1990. A 144-way formation is completed over Quincy, Illinois. Tom Pirus accumulates 132 hours of freefall time in 8,000 jumps. Don Kellner logs 11,000 jumps. Elsinore is closed for good.

1989. The Parachute Industry Association holds its winter meeting on a cruise ship between Los Angeles and Mexico. The Nationals are in Muskogee again.

Experience is something you don't get until just after you need it.

Warning

- Read and follow all operating instructions and all manufacturer specifications, instructions, advice and requirements for use of the equipment.

- Use only manufacturer-recommended, compatible components.

- Examine and replace ANY defective, worn, or deteriorated component of all equipment.

- Examine all gear and equipment, including all fittings, buckles, snaps or other fasteners, before each use of any parachute product.

- Use only those products designed for parachute use.

- Do not exceed recommended or stated forces, speeds or other factors regarding safe use of the equipment.

- Read and follow all warning labels, manuals, instructions, training or experience requirements and recommendations, and all recognized parachute use procedures.

- Check and calibrate all altimeters, timers or other similar equipment before each jump or use.

- Never attempt to use equipment packed, prepared, assembled or fitted by others. Know and examine your equipment before each use.

FAILURE TO FOLLOW ALL WARNINGS, INSTRUCTIONS AND REQUIRED PROCEDURES MAY RESULT IN SERIOUS INJURY OR DEATH.

Chapter Four

Parachuting Emergencies

Causes, Avoidance and Corrective Actions

In the sport of parachuting there are a number of possible emergencies. Happily all are rare. But since we are dealing with machines (aircraft), new elements (air and altitude), high closing speeds (relative speeds between freefalling jumpers as well as terminal velocity approaching the ground), mechanical devices (parachutes), obstacles (trees, power lines, etc.), and last but certainly not least, the human element (you, your jumpmaster, pilot, instructor, and others), you must be educated in these areas; you must be properly prepared.

Canopy malfunctions and other emergencies are not common in sport parachuting but if one happens to you, once may be enough. Therefore, a dispropor-

tionate amount of discussion is being devoted to the problems here and a great deal of your training time will be expended on coping with emergencies.

Emergency procedures are being given separate treatment here in their own chapter, but they are not separate on the drop zone. They are mixed in with your other jump training. In Chapter Two we told you to do a number of things, such as to cover your reserve ripcord handle in the airplane. In this chapter we will explain in detail *why* these cautions are necessary. Not all parachuting emergencies concern parachutes but all do concern parachuting. Injuries may be caused by a crash of the jump plane or a canopy ride into an unexpected pond. In the following pages we will cover everything that can go wrong and explain to you what to do it if does.

Both parachute equipment and skydiving instruction have changed tremendously in the last few years. Now that most parachutists are starting off with more dependable ram-air canopies, piggyback systems, automatic activation devices and more specialized professional training, the rate of injury, both fatal and non-fatal, has dropped and is expected to drop further.

Fatal injury statistics. Some statistics will help to orient our thinking. In the United States, over the last several years, an annual average of 29 people have been fatally injured while parachuting. Since we are in an equipment and training transition, averaging fatality figures for the last several years is not any more accurate than using the latest year. Fatalities dropped to 23 in 1988 and they are expected to drop further. It must be emphasized that some of the categories listed did not kill; the

jumper died for failure to react properly to the situation. Here is the breakdown for 29 who died while parachuting in 1987, the most recent year for which expanded statistics were available.

17.8% were involved in **freefall collisions**; five died in four separate mishaps. The number of fatalities in this category was higher than in most years. Some freefall collisions happen when two or more skydivers run into each other but most occur during opening because the skydivers have not separated far enough after relative work.

17.8% **failed to pull the ripcord or pulled too low**. Some of these fatalities can be traced to medical problems such as heart disease or a history of blacking out. Others are simply unexplainable because it is impossible to interview the deceased jumper. Some of these fatalities may be due to hard pulls on the main, where the jumper simply fails to pull the reserve. Up to one-third of the malfunctions that do not result in fatalities can be traced to a lost pull-out pilot chute handle. Other reasons are accidental reserve openings, pilot chute stuck in throw-out pouch, accidental riser release and premature main opening.

35.8% had **canopy malfunctions** where the main began to deploy and an equipment malfunction began a series of events that led to a fatality. Three of the ten malfunctions were *pilot chutes in tow,* where the pilot chute was deployed but the main canopy remained in, or partly in, the main container. Fortunately ram-air *square* canopies are less malfunction prone (one out of 700 jumps) than round canopies (one out of about 250 for the Para-Commander class round). In fact, during 1988 Roch

Charmet of France made his 5,000th jump on a square without a malfunction. Nearly all experienced skydivers use the ram-air canopy today and all students will use them after January 1, 1990 when USPA's new Basic Safety Requirement goes into effect.

Be careful of canopy malfunction statistic comparisons. Main parachutes malfunction more often than reserve parachutes, due to packing and wear. Mains are usually hastily packed by jumpers wanting to make the next load. Reserves are inspected and repacked slowly and carefully by a licensed parachute rigger every 120 days. And reserves are usually factory fresh with no prior use to result in worn parts.

But squares do malfunction sometimes. Nearly half of the malfunctions are due to knotted lines or slider hang-up. The rest of the main malfunctions are due to bag lock, broken lines, streamers, canopy damage, link problems and *other*.

28.5% had **reserve problems** which are usually main-reserve entanglements. This category of problems is usually smaller.

There were no **landing fatalities** in 1987 but they have occured in other years. Historically, water, powerlines and even moving trains have posed landing obstacles. Higher performance ram-air canopies may be responsible for helping jumpers to avoid landing hazards.

Skydiving is a game of odds. The object of the sport is to improve your odds as much as possible. - Sandy Reid

This Chapter will discuss the causes and accepted corrective actions for each of the above problems. USPA figures reveal there are some 110,000 people participating in parachuting each year. Twenty thousand are active skydivers and 90,000 are students. Of the 2.2 million jumps made each year, 300,000 are by students and 1.9 million are by experienced skydivers.

In a typical year, 1987, there were 29 fatal parachuting accidents in the United States, yielding a rate of one fatality for every 75,000 jumps (at three jumps per day, this will take you quite some time), and one for every 3,800 participants. USPA estimates there is one fatality for every 30,000 student jumps. These jump figures can be compared with one fatality per 2,308 hang gliding flights and the one in 2,582 Americans who perish each year in all accidental deaths (91,000 out of a total U.S. population of 235,000,000 in 1983). It should be pointed out that the above figures include all jumpers, both those who observe safety procedures and those who take chances. The figures even include some documented suicides.

It is interesting to compare fatal accident numbers with other activities: In a recent year over 200 people perished scuba diving, 900 bicycling, over 7,000 drowned, 1154 succumbed to bee stings, and 800 were hit by lightning. Then there are other transportation statistics to compare: In 1982, 43,990 people were killed in highway accidents, there were 1,171 boating fatalities, 235 airline deaths and 1,164 light aircraft *general aviation* fatalities.

Non-fatal injury statistics. And how about non-fatal injuries? Active skydivers can expect to sustain

a serious injury about once every five years. Most student injuries, other than bruises and scrapes, occur to backs and wrists. These injuries are usually caused by poor landings, which are frequently due to a bad flare when both toggles are pulled all the way down behind the jumper's hips, allowing the wrists to contact the ground first when he or she falls backwards. Some instructors estimate that ten percent of the students were injured in the old days of round canopies. Rounds deposit their cargo much faster because they can't be flared. The result was many more leg and ankle injuries. So the 90,000 students making 300,000 jumps could expect 6,000 injuries. Today, the rate is about two percent so the 90,000 students can expect about 1,800 injuries.

Some injuries are serious, some are not so serious and some are surprising. Occasionally a small woman over 30 will break an ankle or leg on the first jump in an apparently soft landing. The weakness is sometimes traced to a pre-existing calcium problem.

By comparison, in 1985, 7,700 people were treated in hospital emergency rooms for injuries received in amusement park rides, 395,000 were treated for baseball injuries and 581,000 for bicycle injuries. In 1985 and 1986 there were 511 *reported* jet ski accidents and the Coast Guard figures that less than 25% of the casualties are reported.

The simple fact is that reserve parachute systems (container, ripcord, deployment system, canopy and pilot chute) can malfunction. It should be used only as a backup in a genuine emergency. - Paul Sitter

The risk and the reward. Thousands of parachutists find jumping to be a great deal of fun, the ultimate outdoor, aviation recreation sport. You must weigh the risk and the reward; it is a personal decision.

Why we jump. The explanation used to be simple: Jumpers were crazy! Some psychologists talked of Freudian death wishes while others believed in fear displacement or denying one fear in their lives by directing their attention to another more managable one. Others theorized that participants in high risk sports were acting out psychopathic fantasies in an attempt to make up for feelings of inadequacy, or to demonstrate omnipotence. So much for the non-jumping, ground hog, whuffo head shrink community.

Fortunately, in the last 25 years, the shrinks have decided that pursuing a high-risk sport is not all that bad. Perhaps more of them have tried skydiving. Bruce Ogilvie, professor emeritus of psychology at San Jose State University conducted a study 1973 of 293 high-risk competitors, including skydivers, race car drivers, fencers and aerobatic pilots, using psychological batteries and personal interviews. Ogilvie found risk-takers to be success oriented, strongly extroverted, above average in abstract ability and superior in intelligence. He found these athletes are rarely reckless in their risk taking; their risk-taking is cool and calculated. He estimates that six percent of the high-risk athletes compete out of anger, or out of deep feelings of inferiority or because they are trying to prove something about themselves. The other 94 percent are emotionally stable. Ogilvie feels risk takers grow up in a *go for it*

world where there are coached to believe they can only learn by trying and perhaps losing. Meanwhile their friends are being told: Don't do that, you could get hurt.

Reserve use. There are few statistics on reserve use. One DZ reported 32 reserve openings out of 11,300 jumps. That works out to one out of every 354 jumps but it includes all types of equipment: round, square, new and old.

Hazard briefings will vary from drop zone to drop zone to fit local conditions. There may be trees, rivers, power lines, hostile farmers, prisons, highways or a girls' school. In fact, those DZs lacking certain hazards may touch on the corrective action for every emergency but lightly. Therefore, when visiting a new DZ, it is imperative that you get a briefing on the area.

Alcohol and drugs. In order to achieve the greatest enjoyment from your parachuting experience, you will want to approach it with an unfogged mind. This means going to bed early the night before and going easy on the booze. Even the common cold will trouble you due to the changes in atmospheric pressure. If your mind and body are not operating at 100%, you will react with less deliberation in an emergency and you will enjoy the jumping less. Remember the lower pressure at altitude amplifies the affects of alcohol and drugs.

It is one thing to be in the proximity of death, to know more or less what she is, and it is quite another thing to seek her. - Ernest Hemingway.

Some fear is good for you. It has been said that the difference between fear and respect is knowledge. Most people fear parachuting because they don't understand it. Fear is the result of ignorance and it is part of nature's protective mechanism; it warns us to beware when we are on unfamiliar ground. The best way to cope with problems is to prevent them in the first place. The key is education. It is unfortunate when someone is injured while engaging in sport, but it is tragic when a second person is hurt for the same explainable reason.

Sometimes the airplane fails

Airplane problems: Engine and structural failures. If the engine is going to fail, it will probably do so when the pilot reduces power after your full throttle takeoff. If the engine quits, he will attempt the best landing he can, straight ahead off the end of the runway. Since you are helmeted, padded with gear and strapped in, you need only assume the

proper position to be prepared. Draw your knees up, tuck your head down, fold your hands across the back of your neck and hold your head down to resist whiplash. As soon as the plane comes to a stop, get out FAST! If you are nearest the door, get moving. There are people behind you who want to get out. There is always the danger of fire, particularly if the aircraft has suffered structural damage on impact. Watch where you step; the plane may have clipped through some powerlines. They can zap you and they can start grass fires. Remember that the wings of the airplane are full of fuel.

The emergency landing position

Occasionally, the jump ship suffers a structural or other mechanical failure. Twisted-on parts sometimes twist off, or a canopy may get draped over the tail jamming the controls.

> *While it is rare, an airplane is a mere machine, and may therefore break.* - J. Scott Hamilton.

Depending upon the situation and the altitude, your jumpmaster will select one of two commands: *PREPARE TO CRASH* or *GET OUT*. The dividing line is usually set at 1,000 feet above the ground, since at this altitude there may be enough time for an orderly exit and the pilot will probably be able to land his *glider* on the runway. The jumpmaster might tell you to jump and pull your reserve on the theory that it is somewhat more reliable than the main and/or he may be concerned about the setting of your AAD. His instructions will depend on the circumstances of the situation.

So, if you are under 1,000 feet, you will land with the aircraft. If you are over 1,000 feet when the rubber band breaks, your jumpmaster will direct you to make a normal static line jump, But you will do it all a lot faster; swing out onto the step and go. Student freefallers may be directed to make a jump and pull, in which case they will open their mains as soon as they clear the aircraft. Or the jumpmaster may sit them in the door, pull their reserve and simultaneously push them out. It all depends on the altitude at the time of the emergency. Licensed jumpers are next, then the jumpmaster and, in the case of severe structural failure, the pilot. The purpose of getting out of the plane is not only to remove you from the area of danger but to lighten the load, making the aircraft easier to control. The jumpmaster goes next to last because he must take care of those in his charge. The pilot goes last (he wears a parachute too) so that he may wrestle the jumpship to keep it flying until you are gone.

The above rules are general and are for students. Experienced jumpers may elect to exit lower. For ex-

ample, if the aircraft is at 500 to 1,000 feet, an expert skydiver may elect to jump and pull the reserve (which presumably opens faster).

Of course you will follow the instructions of your jumpmaster, but sometimes you have to make the decision yourself. In the excitement of solving the engine or other problem, the pilot may allow the airspeed to drop, stalling the plane and allowing it to spin. In this condition the aircraft drops fast and the centrifugal force may pin you against the ceiling. Now is the time to make the decision to scramble and **get out.**

Depending on the size of your jump ship and the procedure at your drop zone, your static line may be hooked up on the ground, at 1,000 feet or on jump run. Whether or not your main is hooked up before takeoff may determine what type of escape you can make in case of an aircraft emergency. For example, if you are hooked up prior to boarding, and the plane crashes on takeoff, you can expect your main parachute to unpack about ten feet from the door (the length of your static line).

The final point to remember is to watch your jumpmaster for orders. When you receive them, carry them out quickly and without panic.

Why would anyone want to jump out of a perfectly good airplane? The problem is that there is no such thing as a perfectly good *airplane.*

Open parachute in the airplane. Several times in the past jumpers have been pulled through the side of the jump plane when a container opened and a canopy escaped out the door. Rarely does this result in a fatality but usually there is severe damage to both the jumper and the aircraft.

The jumper whose reserve escaped out the door of this aircraft was lucky; he survived. Notice how close he came to taking out the control cables which run through the door channel and just inside the torn Alclad.

If either the main or the reserve opens prematurely in the aircraft, one of two things will happen; the pilot chute and/or canopy will either start out the door or remain in the plane. You have only one course of action for each situation.

Sometimes the **main** will burst open while you are in the back of the plane; the pin works its way out.

In this case, it is a simple matter to move backward, pinning the errant canopy against the bulkhead. Show the problem to your jumpmaster immediately. Once satisfied that you have it well secured, disconnect the main canopy from your harness by operating the canopy releases (the method depends on the type of system you are using). If, somehow, it should get out the door later, you don't want to be connected to it. Now sit on the canopy and pilot chute so they won't get away, and ride the plane down.

Or perhaps since you were in the back of the plane, you weren't vigilantly guarding your **reserve** ripcord handle and it was snagged out as you moved around trying to find a comfortable position. Grab the reserve pilot chute and canopy, cover them and hold them tight. Call the jumpmaster's attention to the problem immediately. The reserve creates a greater potential danger than the main, as it cannot be disconnected from the harness.

If, however, either of your canopies starts out the door, you will follow it out. You have, at most, two seconds and if you hurry, you will experience a near-normal canopy ride to somewhere in the vicinity of the airport. But if you are slow, the developing canopy will act as a giant anchor, extracting you not through the door but, more than likely, through the side of the aircraft producing great injury to you both.

> The Right Stuff: Not mere bravery in risking one's life but the calculated approach to the impossible, or to death, as always controlled, seeking and passing a "seemingly infinite series of tests." - Tom Wolfe.

The best solution is prevention. Always guard and protect your ripcords, canopy release handle and pins. Pins can snag on aircraft walls, door edges, and the gear of other jumpers. Move about the aircraft cautiously and only when told to do so by your jumpmaster.

Dangling static line. After the jumpmaster dispatches each student, he will unhook the static line and stow it in the back of the aircraft or under the pilot's seat. If he forgets to disconnect it, we have one ingredient for another horror story. During the scramble to exit, jumpers have managed to get those long pieces of webbing half-hitched around their ankle. The result is a surprising and abrupt halt just a short distance outside the door. Due to the weight of the gear and the wind, it is impossible for the jumper to climb back up. There should be a knife in the plane to cut you loose and, of course, every experienced jumper in the plane should be carrying one. If there aren't any knives handy, you will hope the pilot is sharp enough to think of breaking some glass out of one of the instruments in the panel because your alternatives are not terribly pleasant. Either you can pull your ripcord and jerk your leg off, or you can wait it out and suffer severe runway rash when the plane lands. One jumper caught in this situation lucked out, he was jumping from a helicopter. The pilot set him down gently and red-faced in front of everyone on the DZ.

Parachute malfunctions. A *malfunction* is any failure of the system to provide a normal rate of descent, and this includes loss of canopy control. Malfunctions are normally caused by one or a combination of the following: bad packing, poor body position

during canopy deployment and/or faulty equipment. There are some malfunctions, however, that just happen; parachutes are good but not perfect.

Failures of the main parachute can be divided into two areas. Either nothing comes out and you have a *total malfunction*; or the canopy starts to open, but it does not deploy properly and you have a *partial malfunction*. Each of these two problems will be broken down still further in this chapter.

Because of the possibility of an equipment malfunction, the opening altitude (for A and B licensed skydivers) is set way up at 2500 feet, a second *reserve* parachute is worn, and you are drilled in its use. But even with the 2,500 foot safety margin or *cushion*, you must be aware of the time, speed and distances involved. If you exit the aircraft at 2500 feet, for example, you will begin to accelerate; you start off at zero vertical speed and then fall faster and faster until you reach terminal velocity (more about that later). If you didn't have a parachute, it would take you about 18 seconds to reach the ground. In the case of a partial malfunction, you will have a little braking from your canopy and this give you a bit more time. But even if you have a total, you should, allowing for reaction time, be open under your reserve at well above 1,000 feet. In fact, while it seemed like an eternity to you, your friends on the ground will tell you that you performed quickly and efficiently; you will be surprised at how fast you react to a malfunction. Your main parachute takes 3-4 seconds to open and the reserve may be just slightly faster. Even at terminal velocity, which is the fastest you can fall, four seconds translates into 700 feet.

Total malfunctions. If you haven't been jerked upright by the sixth segment of your *thousand count*, you are already into the emergency procedure for a total malfunction. Each type of total will be covered in the order in which it might occur in a jump sequence.

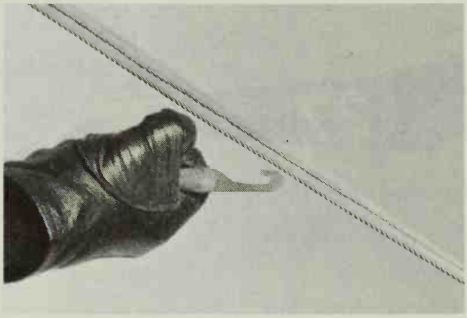
Student in tow. One of the more dramatic problems is the static line hang-up or *student in tow*. It occurs when the jumper, or some part of his or her equipment, entangles with the static line, preventing separation. The jumper winds up suspended about ten feet below the aircraft by the long nylon web. This emergency is extremely rare and if it does occur, it will probably be because the static line is misrouted (perhaps under the harness) and was missed in the equipment check. Or you and the jumpmaster failed to keep the line high and clear as you moved into the door to jump. Or perhaps you performed some wild gymnastic maneuver instead of a stable exit, and became entangled in the line. Some students, despite all their training, yell "arch thousand" and then let go with the hands, leaving the feet firmly planted on the step and perform a back loop.

The hang-up presents all of you with a perplexing situation. The jump ship will be more difficult to fly; in fact, the pilot may be unable to maintain altitude because of all the extra drag. You don't want to land with the aircraft this way, as even on grass you will suffer severe *runway rash*. And, you shouldn't pull your reserve because you don't know how the entanglement occurred; you don't know how you are attached. The static line might rip loose or, then again, it might rip you loose. Or you might all stay

connected, crashing the plane. As with other emergencies, there is an accepted procedure. You, your jumpmaster and pilot must be familiar with it.

If you pull the reserve while in tow, you may not rip loose. You could slow the plane to a stall. Here, the owner, jumpmaster, pilot and aircraft were all lowered to earth under the same 24' canopy.

The pilot will be diverting the aircraft to a safer, open area and will be trying to gain altitude. If you relax, you will probably assume a stable towing position either face or back to earth, which is better than twisting in the wind.



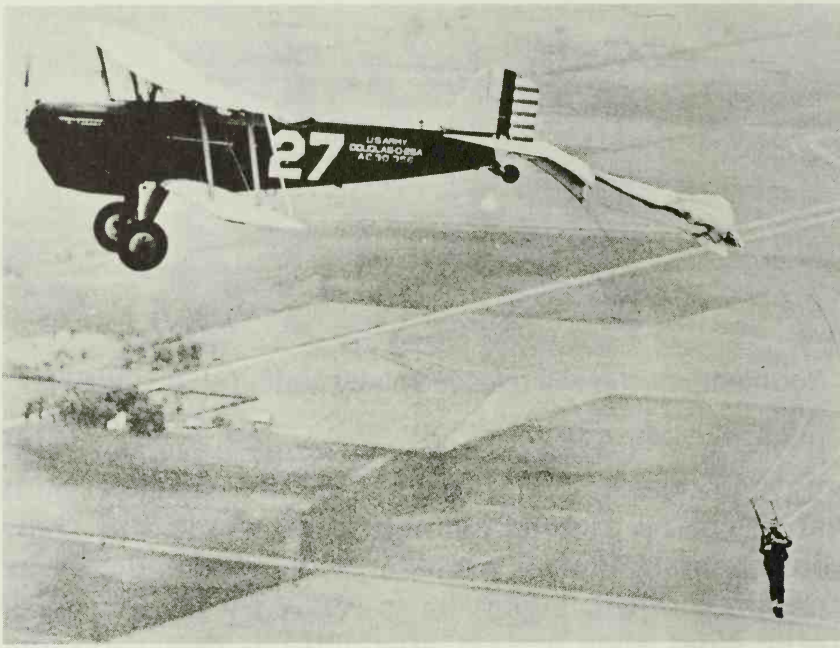
Your jumpmaster will release you by cutting your static line

If you are *conscious* and your arms have not been injured, signal the jumpmaster by placing both hands on top of your helmet. Your hands will show you understand the problem and are ready. Your jumpmaster will signal he is ready by holding up a knife. Now, your jumpmaster will cut the static line and you will fall away. Follow the procedure for a total malfunction: pull the reserve. Be sure you are cut loose before you pull.

If you are *unconscious* or otherwise incapacitated, you won't be able to give the OK signal to your jumpmaster. Your static line will still be cut but you will rely on your automatic activation device to pull your ripcord.

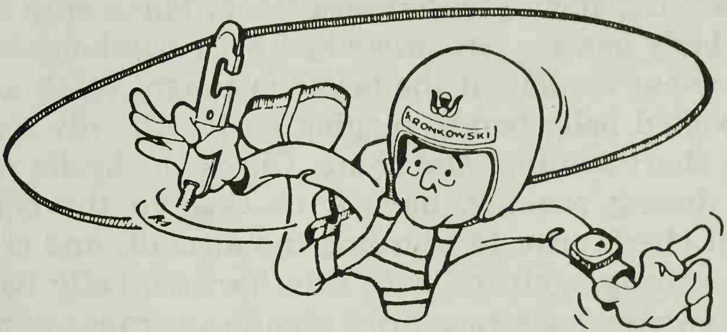
> A chance is *what you take before you think about it.* A calculated risk *is what you take after you have evaluated all possible factors and have determined that risk.* - Craig Elliot.

Back when reserves were detachable and worn in the front, a jumpmaster could lower an unconscious student by unhooking his own reserve and attaching it to the static line. The static line had to have an extra ring for attachment to the reserve to make this method of rescue possible.



Many years back, this Army test jumper managed to hang his canopy over the tail. A knife was lowered to him from a second plane. He cut himself free and opened his reserve. (The canopy release was a later development.)

There is also a second type of main canopy in-tow emergency to be considered. Normally, you fall away from the step so quickly that it is virtually impossible to tangle your canopy in the tail. But if one of your parachutes opens when you are on the step, entanglement may occur. If you find yourself in this situation, look at your reserve ripcord handle, jettison your main canopy and pull your reserve immediately.



Static line not hooked up. Occasionally, despite all procedures, a student exits the jump plane without being attached to it. While hooking up the static line is the jumpmaster's responsibility, you must verify that it is attached prior to exit. If you forget to check and find yourself in freefall, follow the procedure for a total: pull your reserve.

Pull-out verses throw-out. The pull-out and throw-out pilot chutes are preferred by experienced jumpers, but students use the ripcord and coil spring pilot chute combination. For a detailed explanation of these three systems, see the Equipment Chapter.

Common *throw-out* malfunctions are trapped pilot chute, pilot chute in tow and horseshoe.

—Trapped pilot chute. If the pilot chute is not properly stowed in its pocket, it may bunch up and jam when you try to extract it. The trapped pilot chute results in a *hard pull* which may or may not be cleared. If you find you have a hard pull, try one more vigorous pull. If you get no result, then go for your reserve.

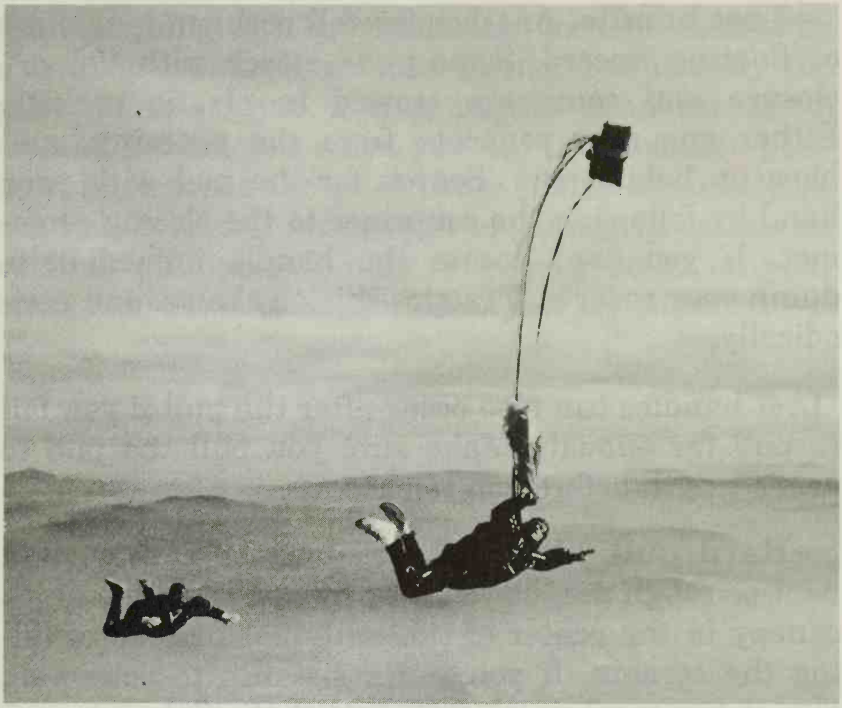
—**Pilot chute in tow** may be short or long. It is *short* when the pilot chute bridle is looped around something such as a harness strap. Make sure that the belly band is not twisted on belly band–mounted throw-out models. If the bridle is caught (such as in a twisted belly band), tugging on it will only result in a short trailing pilot chute. Check the bridle routing during packing, have it checked in the equipment check prior to boarding the aircraft, and check the routing again prior to exit. Twisted belly bands and twisted leg straps are a significant cause of pilot chutes in tow.

The pilot chute in tow is *long* when the pilot chute pulls the bridle to its full extent, but does not pull the pin securing the main container. The failure may be due to a damaged pilot chute (producing insufficient drag), a rough pin, a tight main container (canopy stacked too high), or a closure loop which is too short. The long pilot chute in tow is more likely on sub-terminal velocity jumps.

Make sure the bridle-pin connection is not worn, that the pin is smooth and curved, not straight, and that the locking loop is not too short.

If you are faced with a long pilot chute in tow, never try to clear it. Do not waste time breaking away or rolling to pull on the pilot chute bridle. There is simply not enough time to analyze, decide on a course of action and correct the problem. Assume a horizontal position and pull your reserve.

How to handle a pilot chute in tow is a subject for great debate and much beer has been consumed discussing it. While there are exceptions to the *pull your reserve* rule, time is too short to consider them.



The horseshoe malfunction occurs when the main container opens prematurely

—**Horseshoe**. This malfunction can result from bad maintenance, failure to check equipment or incompatible canopy/container systems. It happens when the locking pin is dislodged, allowing the bagged canopy to escape before you have removed the pilot chute from its stowage pocket. (The horseshoe can also occur if the pilot chute catches on your foot or under your arm, but these are rare occurrences today.) The danger is that a pulled reserve may tangle with the horseshoed main as it tries to deploy. If you experience a horseshoe, pull the main pilot chute immediately. If you can't, break away and deploy the reserve.

Common *pull-out* malfunctions are the lost handle and the hard pull.

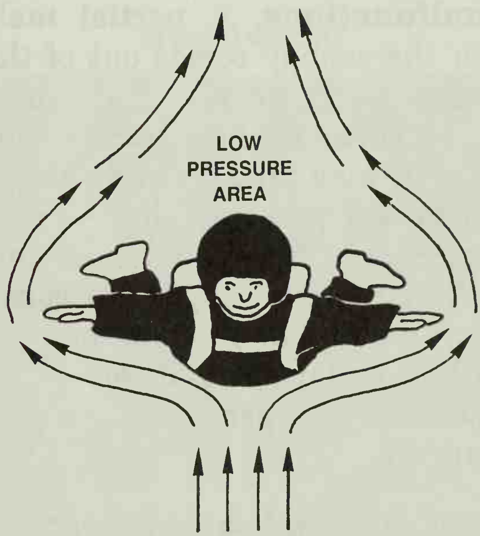
—Lost handle. Another freefall problem is the lost or floating ripcord. Some puds attach with Velcro® closure and some are stowed in elastic pockets. Either one may separate from the container and blow up behind you. Search for the pud with your hand by following the container to the closing grommet. If you can't locate the handle immediately, dump your reserve. Practice this on the ground periodically.

Lost handles can also occur after the pull if you fail to pull far enough. Make sure you pull the pud to arm's length before you release it.

—Hard pull. The hard pull may be caused by a bent or rough pin, or you may have packed too much canopy in the center of the container instead of filling the corners. If you feel resistance to your pull, give it two more quick tries and then, if that doesn't do it, pull your reserve ripcord. After a number of jumps, it's normal to become somewhat complacent about the pull; you may give it a relaxed, half-hearted jerk. The pull may take as much as 10kg (22 lbs.), so pull again. If continual hard pulls are bothering you, wax your pin by drawing it over a candle (or a waxy Coke cup from the trash barrel). The wax will make quite a difference, though it will only last for 2-3 jumps and you will have to do it again.

Pilot chute hesitation. A problem you could have with your *reserve* deployment, or with a main with a spring loaded pilot chute, is the common pilot chute hesitation. Hesitations can also happen to hand-deployed mains, but they are not as common. Hesitations occur when the pilot chute momentarily flutters in the low pressure area behind you rather

than catching air. The hesitation may be caused by a bent or weak pilot chute spring, but usually the pilot chute is just sitting in the dead air space created behind you when you are in the stable position. Sometimes the pilot chute jumps upon release but fails to travel far enough to get a grip on the air rushing past you. It may drop back down on your back and just bounce around or just lay there.



To correct the problem, you may turn on your side allowing the airflow to inflate the pilot chute and pull it free, you may peek over your shoulder after pulling the ripcord, or you may sit up to dump. This last method of pulling in the start of a backloop also reduces the opening forces on your body.

> *Passing through two grand at terminal with nothing out is not the time or place to be paging through this book.* - Curt Curtis.

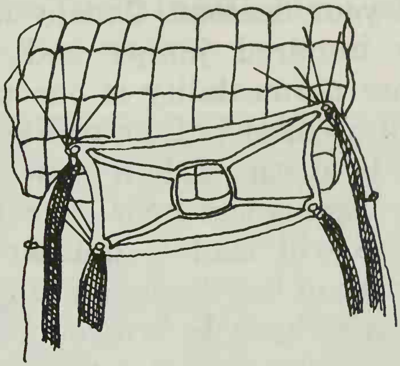
Total. Of all the possible equipment malfunctions, the *total* is the safest to deal with because there is no other garbage over your head to interfere with the deploying reserve. While the total is the easiest malfunction to rectify, remember it also presents you with the least amount of time in which to act. Do not spend time trying to locate a lost handle; you do not have time. Do not waste time breaking away; a loose riser could tangle with a deploying reserve. When in doubt, whip it out!

Partial malfunctions. A partial malfunction is one in which the canopy comes out of the container but does not properly deploy. The canopy may not inflate (e.g. a streamer which hardly slows your descent at all) or it may take on some air (e.g. end cell closures, which will probably slow you enough for a safe landing). So, partial malfunctions may be major and minor. An additional important consideration is that they may be stable or spinning. Most partials can usually be attributed to an error in packing or poor body position on opening. Some partials, however, just happen.

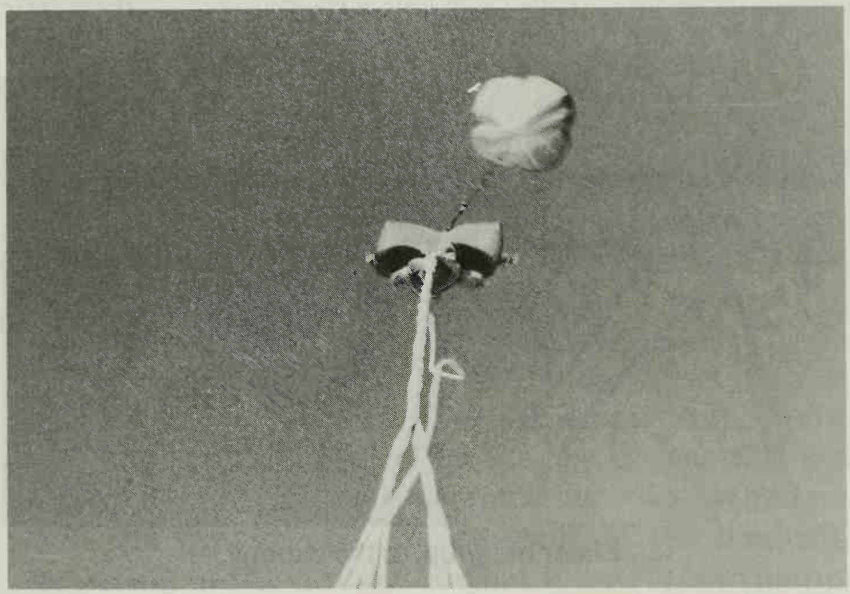
Some partials are so minor, most instructors do not even classify them as malfunctions. Some of these *things that just happen* are line twists, end cell closures and a slider that has not fully descended.

A good canopy is rectangular and flies straight once the slider is down and the brakes are released.

> *One of the great attractions of the sport to many of us is that it demands competence and skillful decision-making under pressure.* - J. Scott Hamilton



A good canopy

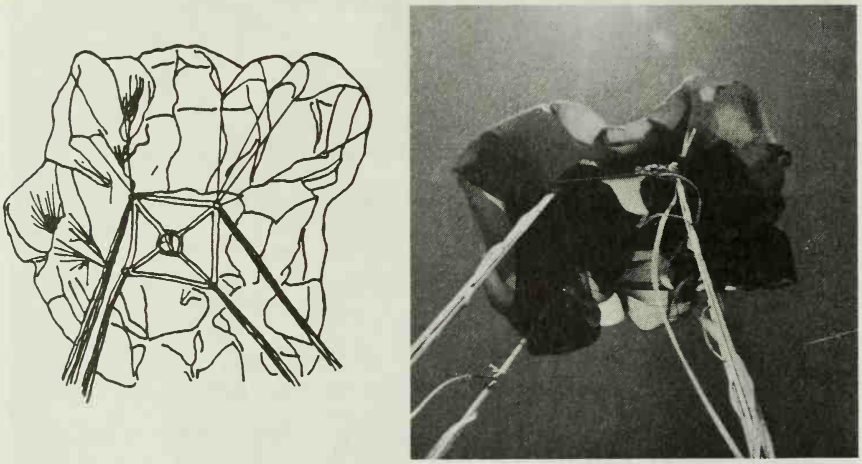


Bag lock

Bag lock presents you with trailing lines, bag and pilot chute, but the canopy will not come out of the bag. This problem is not likely to clear itself. Break away and pull your reserve.

What you have to do is easy. It is where you have to do it that is the problem. - Robert Dormidy

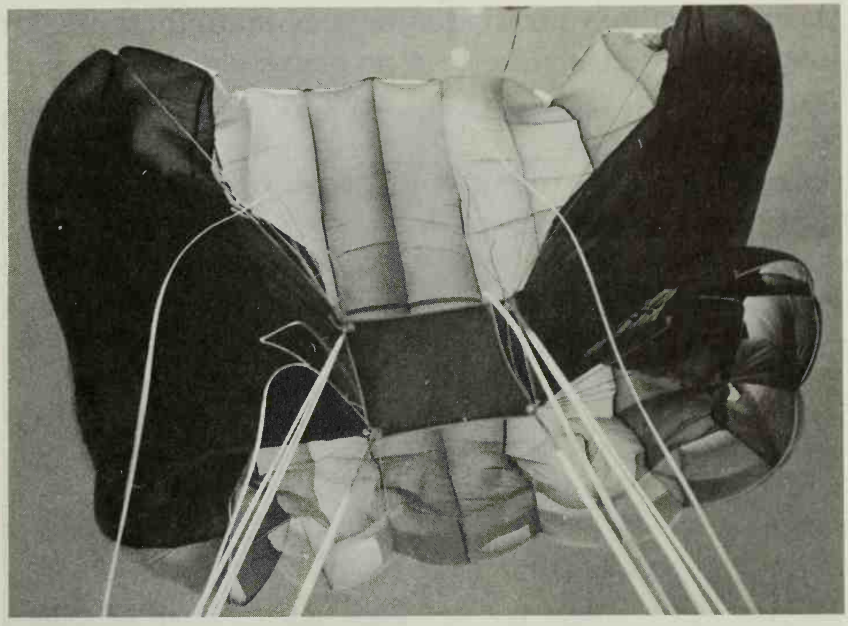
The snivel is a slow, mushing opening which hardly slows your descent. Canopy fabric opens up after a few hundred jumps and becomes more porous. Higher permeability is one cause of a slow opening. Look up after pulling to watch your canopy open. Learn to distinguish a slow opening snivel from a never opening streamer. Sometimes replacing the pilot chute will lead to quicker openings. Try packing the nose of the canopy in different positions, but check with a rigger before you experiment. Contact the manufacturer about resetting the brakes 2" higher. Then the canopy will take to the air with the tail somewhat higher giving the leading edge a better bite of air.



Slider hang-up, at the canopy

Slider hang-up, at the canopy. The slider may hang up at the top of the lines because it is caught in the lines or caught on the slider stops. Grommets become battered and rough as they slide down and hit the connector links at the risers. The links should be fitted with plastic sleeve buffers. Make sure the grommets are smooth. A slider hang-up at the canopy is a high-speed malfunction and will be

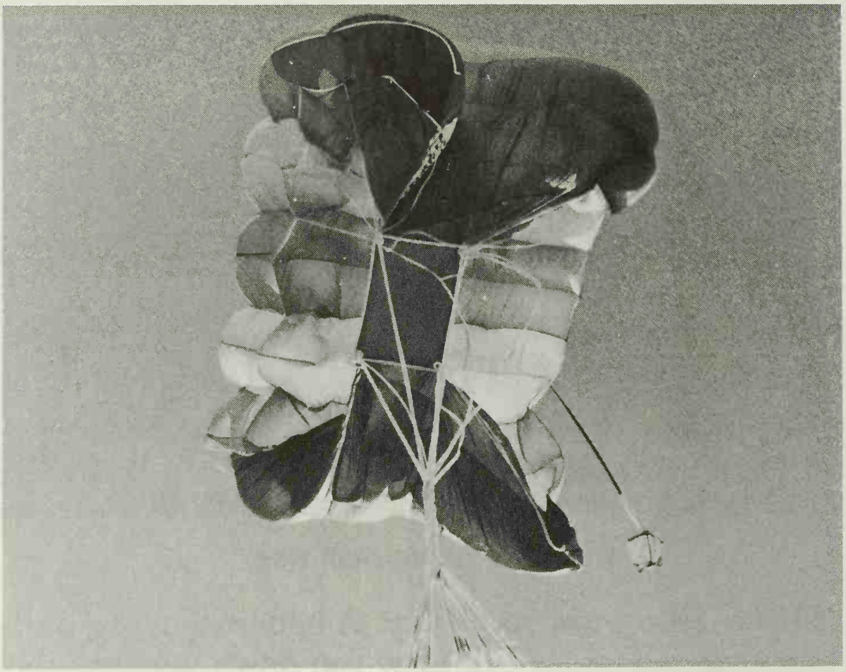
hard to clear. You may be upright but you are descending quickly. There is little time, so jettison your main and pull your reserve.



Slider hang-up, half-way

Slider hang-up, half-way. A slider hang-up partway down the lines will slow you down, but possibly not enough for landing. Release the brakes and pull the toggles down to your crotch for two seconds to stall the canopy and relieve some of the spanwise spreading of the canopy. Repeat if necessary (pump). If the slider descends to within 10" or 12" of the connector links, that is close enough. The slider may be caught higher in a suspension line or steering line. Let both toggles up to determine whether the canopy will fly straight. If you have to pull down the opposite toggle to more than shoulder level to maintain straight flight, the canopy will probably be unstable. Break away and pull your reserve.

If the slider comes down the lines part-way and stops, the canopy has probably changed in some way. Measure the line lengths and compare opposite lines. Check the slider grommets for damage. Send the canopy to your rigger or the manufacturer for inspection.



Line twists

Line twists. Sometimes, the bag rotates a few turns as it lifts off. Now you find it difficult to get your head back to look up at the canopy. The problem is that the risers are closer together and twisted, instead of spread. These twists can happen with or without your help. If you are kicking, rocking or twisting just as the bagged canopy lifts off, you can impart a twist to it. The principle is the same as when you give a Frisbee disc a flip of the wrist on launch. Line twists are more common on static line than freefall jumps.

Quickly determine your altitude, whether the canopy is flying straight, and which way the lines are twisted. Reach above your head, grab the risers and spread them to accelerate the untwisting. If necessary, throw your legs in the untwist direction. Line twists are worse on a ram-air canopy than on a round one because you cannot control the canopy until the twists are cleared and this may take 30 seconds. If the canopy is spinning in the same direction, you may not be able to untwist faster than it is twisting. Do not release the brakes until untwisted. While you have the risers spread, check your canopy to make sure nothing else is wrong with it. A spinning canopy descends quickly. If you haven't untwisted the lines by 2,000 feet, break away and pull your reserve.

Premature brake release. Ram-air canopies are packed with their brakes set to prevent the canopy from surging on opening. If one brake releases on opening, the canopy is likely to turn rapidly, which can escalate into a spin and/or an end cell closure if not corrected immediately. Grab both toggles and pull them down to your waist. This maneuver will release the other brake, reduce your forward speed, stop the turn and let you see if any lines are broken.

Broken steering line. When you find one of your steering lines has snapped or floated out of reach, release the other brake and steer the canopy by pulling down on the rear risers. Do not try to steer with one control line and the opposite riser. The turns will be inconsistent and you may find yourself in a dangerous low turn when you flare for landing. Pulling down on the risers may be hard, but it will steer the canopy. The canopy will probably want to

turn in the direction of the good control line. If you cannot make the canopy fly straight with the opposite riser, break away and pull your reserve. If the broken line wraps around the slider, do not try to pump the slider down any further. It will only make the turning worse. Reserve some energy to pull down on both risers at about 15 feet from the ground to flare the landing.

Broken suspension line. Most line breaks only put the canopy into a slight turn. Correct the turn with opposite toggle pressure. Occasionally the broken line causes the slider to hang up.

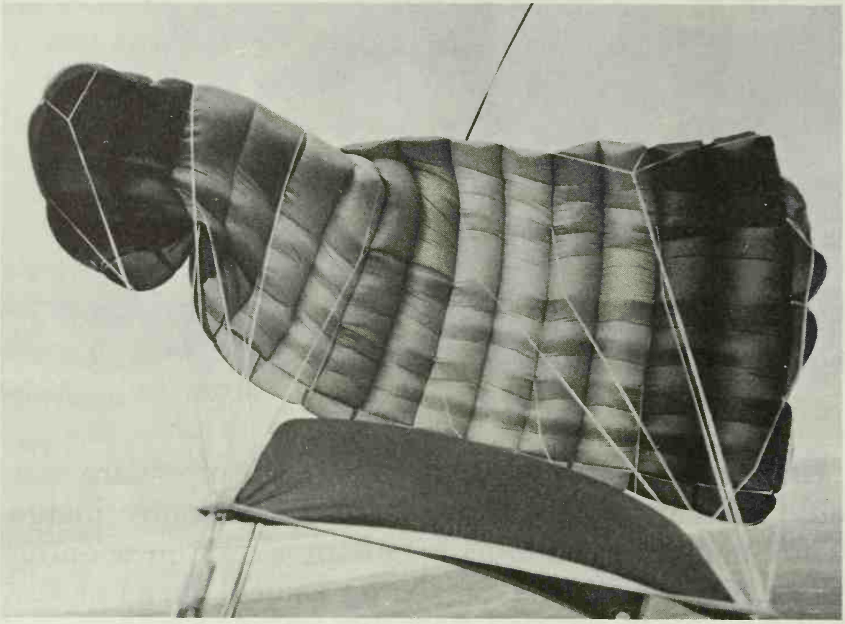
Pilot chute problems. The pilot chute may fall over the leading edge of the canopy and reinflate underneath, usually causing a turn in the distorted canopy. If the canopy cannot be controlled with toggles, break away and pull your reserve.

Rips and tears are not common on ram-air canopies and may usually be ridden in. Even a rip from leading edge to trailing edge on one surface can probably be controlled. Make slow, shallow turns and flare slowly for landing. The question is whether the canopy is controllable with toggle pressure no lower than your shoulder. If not, break away and pull your reserve.

Violent spin. Unless you can tell immediately that you have an unstowed brake, break away and pull your reserve. If you have plenty of altitude, push the toggles down to the crotch for two seconds, then let up slowly. If the spin continues, break away and pull your reserve.

End cell closure

End cell closures occur when the pressure outside the canopy is greater than the pressure inside. They usually occur during canopy surge on opening. Closures can also be caused by radical turns or turbulent air. Turbulence can occur on hot, no-wind days, on windy days downwind of trees and buildings, and during stormy conditions. Light-weight jumpers under large canopies (called *low wing loading*) will experience end cell closure more frequently than other jumpers. To *avoid* end cell closure, fly with one-quarter to one-half brakes. To *counteract* end cell closure, push the toggles down to your crotch for a few seconds, until the cells inflate, then let the toggles up slowly. Repeat if necessary. End cell closures are not a major concern. Keep the canopy and land it, if it is not spinning. If the end cells collapse below 500 feet, do not try to reinflate them. When you flare for landing, the cells will probably pop open. If your canopy is an older one without crossports (holes in the ribs between the cells), contact the manufacturer for crossporting instructions.



Line over

Line overs can occur when a brake lock releases during opening allowing one side of the canopy to surge forward, over itself. If you are on a very high clear and pull, you may try to pull down on the end lines to make the other lines slip off. If you are at normal pull altitude however, you do not have time for this maneuver. Break away and pull your reserve.

Combination malfunctions. When confronted with more than one malfunction, correct for line twists first. The canopy will be uncontrollable until the twists are removed. When in doubt, whip it out.

> As in all emergencies, it would be wrong to think that they happen on every flight but it would be foolish not to prepare for them. - Charles Shea-Simonds.

Tandem jumping malfunctions may be aggravated because terminal velocity is much faster than when jumping alone. This is because the weight is doubled while the effective drag area of the two falling bodies is not.

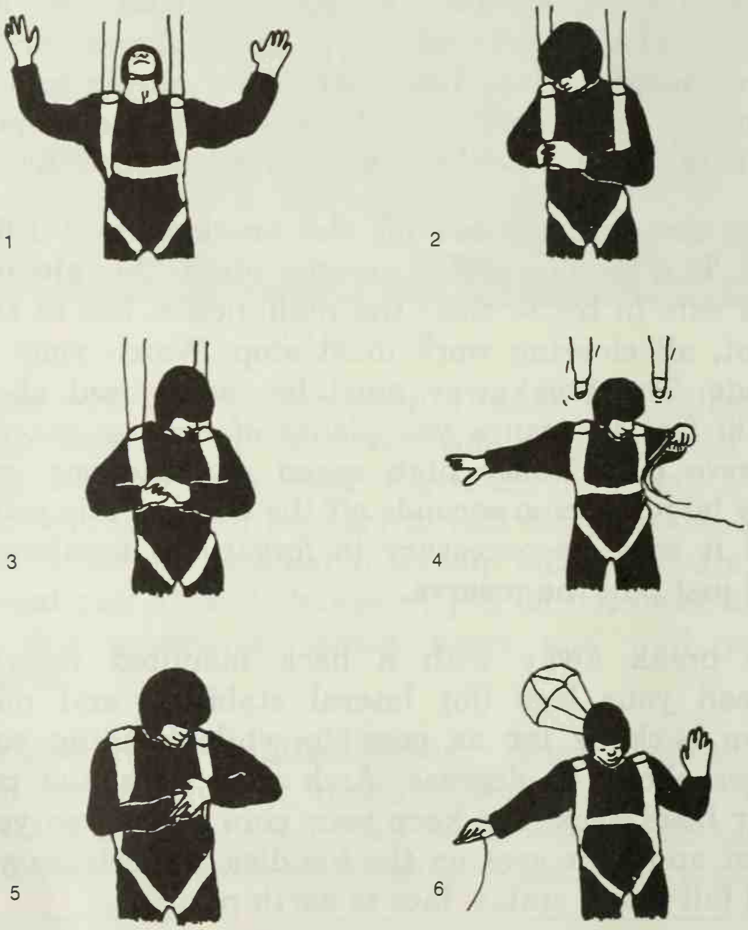
The breakaway or *cutaway* is an emergency procedure which involves jettisoning the main canopy prior to deploying the reserve. Originally, the *cutaway* was performed with a knife, and the lines were cut to separate the canopy. Today, we use canopy releases to *breakaway*. The breakaway procedure should be executed immediately during rapidly spinning malfunctions, because ever-increasing centrifugal forces will make arm movement difficult.

The decision altitude for the breakaway is 1,800 feet. This is your safety margin; above this altitude it is safe to try to clear the malfunction but at this point, all clearing work must stop. Watch your altitude. The breakaway must be commenced above 1,600 feet to assure you plenty of time to get the reserve out. Under high speed malfunctions, you may be just seven seconds off the deck at this point, and it may be necessary to forget the breakaway and just pull the reserve.

To break away with a back mounted reserve, spread your legs (for lateral stability) and push them back as far as possible while bending your knees about 45 degrees. Arch your back and pull your head back, but keep your chin resting on your chest and your eyes on the handles. On release you will fall into a stable, face to earth position.

Students are generally not aware of how quickly 20 seconds pass. - Betsy Robson.

Body position during the breakaway is very important. If you are not falling away correctly, you may become entangled in the canopy and/or lines of your deploying reserve. Even with good body position, breaking away from a violently spinning malfunction may throw you tumbling across the sky.



The breakaway sequence

The breakaway procedure is as follows:

—Two Action System. The TAS has two handles. You pull the first one (usually a Velcro-attached pillow handle located on the right-hand main lift web) to release both risers (a single point release). Then you activate the reserve by pulling the other handle (usually located on the left-hand main lift web).

A. *Total malfunction* (nothing out). Do not waste precious time breaking away; just pull the reserve.

1. LOOK at the reserve ripcord handle and arch.

2. REACH for the reserve ripcord handle with both hands.

3. PULL the reserve ripcord handle vigorously using both hands.

B. *Partial malfunction* (canopy out but not working properly).

1. LOOK at the breakaway handle and arch. The arch should keep you from making a backloop when you jettison the main.

2. REACH for the breakaway handle.

3. LOOK at the reserve ripcord handle before breaking away.

4. PULL the breakaway handle and throw it away while continuing to keep your eyes on the reserve handle.

Aviation is not in itself inherently dangerous. But to an even greater degree than even the sea, it is terribly unforgiving of any carelessness, incapacity or neglect.

5. REACH for the reserve handle with both hands.

6. PULL the reserve ripcord.

7. CHECK over your shoulder for a pilot chute hesitation.

8. CHECK your reserve canopy, look around and prepare to land.

—**The Single Operation System** is a single handle/single motion system. The S.O.S. has a combined handle, usually on the left main lift web, to release both risers and activate the reserve. The S.O.S. has a line (Stevens lanyard) from one riser to the reserve ripcord. The purpose of the S.O.S. is to eliminate one of the motions in the breakaway sequence—pulling the reserve. Half a breakaway is worse than no breakaway at all.

The S.O.S. usually produces full deployment of the reserve canopy in less than 100 feet. If you find a Stevens lanyard on your piggyback harness/container assembly, you should leave it on. When you and your instructor develop enough confidence that you will pull the reserve after a breakaway, you can do away with the line if you wish.

In the event of a *total or partial malfunction*:

1. LOOK at the combination release/ripcord handle and arch.

2. REACH for the combination handle with both hands.

Out of 10,000 feet of fall, always remember that the last half inch hurts the most. - Captain Charles W. Purcell, 1932.

3. PULL the combination handle with both hands to full arm extension.

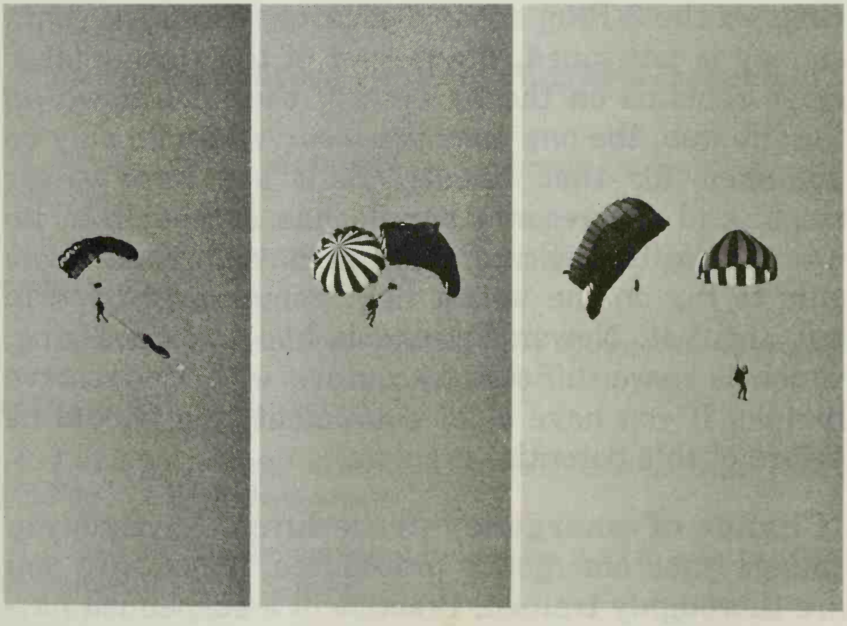
4. REACH back with one hand, grasp the cables where they come out of the housing.

5. PULL AGAIN to clear the cables and

6. CHECK over shoulder for a pilot chute hesitation.

7. CHECK the reserve canopy, look around and prepare to land.

Never depend on the reserve static line device (Stevens lanyard). Always pull your reserve manually immediately after breaking away.



The canopy transfer

—**Canopy transfer** is a third type of breakaway procedure sometimes used in Canopy Relative Work by those who believe *something is better than nothing*. If your main canopy becomes damaged or tangled on a jump and it is still flying forward, you may pull your round reserve and drag it behind you, full of air. Once the reserve canopy is inflated, jettison the main. This maneuver is extremely risky with a square canopy as two squares usually fly around and into each other.

Harness shift. When you jettison the main canopy, your harness will shift downward taking the reserve ripcord location with it. Therefore, it is essential that you keep your eyes on the reserve ripcord handle when jettisoning the main canopy.

Large ring and ripcord handle. Older equipment used a plain round ring for the largest of the rings in the 3-Ring canopy releases. When the main canopy is jettisoned, the largest of the riser release rings remains on the harness. If they flop down on the lift web, the one near the reserve handle may be mistaken for that handle. Both are large silver rings, and the reserve handle has shifted from its normal position. Some jumpers have broken away only to tug on the wrong ring. Some never lived to tell about it. Newer equipment has a shaped ring, which is more difficult to confuse with the reserve handle. If you have older equipment, you should be aware of this potential problem.

Change of emergency procedures. Anytime you change your emergency procedures, make sure you are thoroughly trained. Practice in a suspended harness until proficient on the new equipment. Each procedure is different and you must not waste pre-

cious seconds in an emergency thinking about what you should do. You must act automatically and quickly. Review your emergency procedure prior to each jump.

Breakaway training is essential to assure that it will be accomplished completely, quickly and well. Training must take place in a suspended harness which is easy to rig up. Simply tie an old set of risers to an overhead beam and attach them to your harness. The drill must be repeated again and again until it becomes mechanical and automatic, so that you will perform correctly and without hesitation should the time come.

Emergency priorities. Think about and review the seven priorities of parachuting:

1. **Pull**—Open the parachute.

2. **Pull at the assigned altitude or higher**—whether stable or not.

3. **Pull with stability**—to improve canopy opening reliability.

4. **Check the canopy**—promptly determine if the canopy has properly opened.

5. **Activate the reserve**—perform the appropriate emergency procedures if there is any doubt that the main canopy is open properly and is controllable.

6. **Land in a clear area**—a long walk back is better than landing in a hazardous area.

7. **Land safely**—be prepared to perform a PLF with the feet and knees together to avoid injury.

Jettison the malfunctioned main canopy

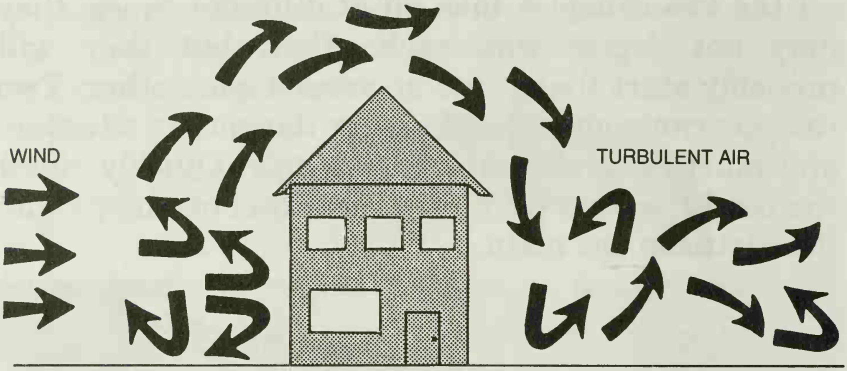
Two canopies open. You may find yourself confronted with two fully open canopies; this can happen in several ways. The automatic activation device on your reserve could fire when you are happily flying your canopy through 1,000 feet. Another possible cause is reacting very quickly to a pilot chute hesitation.

> *Asking students to make any transition early in their jumping career is asking for trouble. Expecting them to adjust to a different type of deployment device, a different type of canopy, or even a different type of jump (e.g. RW) early in their jumping career is not realistic and can lead to problems.* - Paul Sitter

If the two canopies take off at different times, they may not deploy into each other, but they will probably start flying into or around each other. Two ram-air canopies present a very dangerous situation and must be dealt with immediately. Quickly check the condition and position of the reserve canopy and then jettison the main.

Landing problems. Most of your landings will be normal and in the center of the drop zone, but unusual things do happen, like landing in water, in sudden high winds or descending through power lines.

Turbulence. Bumpy air may be encountered at altitude and it has been known to close end cells and upset canopies. Jumpers have been robbed of their wings, to be left back in freefall at 75 feet. Bumpy air may occur on windy days and on hot, no-wind days. Keep your canopy inflated during turbulence by flying at one-quarter to one-half brakes and make gentle turns. If turbulence causes a partial canopy collapse of your canopy, pump half to three-quarters brakes to aid reinflation.



Obstacles may produce wind turbulence

Turbulence near the ground may be caused when wind flows over obstacles such as buildings and tree lines. Avoid landing on the downwind side of any obstacle. The air may be bumpy or descending. The stronger the wind, the farther downwind the turbulence will exist, and the taller the object, the higher the turbulence will be. Turbulence can be significant downwind as far as ten times the object's height.

Turbulence also occurs behind other ram-air canopies. Stay away from an area directly behind another canopy, about 45 degrees up from the trailing edge.

Dust devils are very dangerous. One jumper landed, his canopy deflated, and then it was reinflated by a dust devil. The dust devil picked him up and then threw him back on the ground. He died from the impact. In windy conditions, pick up your deflated canopy immediately.

> *Stay clear of buildings, trees and other solid objects that might be likely hiding spots of turbulent air or no air at all!* - Daryl Hedges

High winds. If you find yourself in high winds, look behind you as you back up. Many jumpers *back* into powerlines and fences. When landing in high winds, let go of one toggle as soon as your toes touch the ground. Keep the other toggle at the flare position and quickly pivot 180 degrees in the direction of the depressed toggle. Steer the canopy into the ground. Run toward and around it, if necessary.

Thunderstorms are violent vertical liftings of air masses, a phenomenon which can build cumulonimbus clouds from near the ground to anywhere from 50,000 to 75,000 feet. Thunderstorms possess violent updrafts and downdrafts, along with lightning. While the West Coast of the U.S has only about five thunderstorms each year, the Northeast has 20, and Florida has 80 to 90. Jumpers have been caught in cumulonimbus clouds for some pretty scary and wet rides. When the storm clouds appear, put the gear away.

Trees, power lines and water hazards: Elbows to the chest, hands with steering toggles in front of face and throat, feet and knees together. Look down.

The tree landing

The tree landing is rarely hazardous. Your canopy will lower you gently into and through the tree as you slow further, breaking the thinner branches. You will probably go all the way through to the ground and make a normal parachute landing fall.

If you can't avoid the trees, face into the wind to minimize your ground speed, pull half brakes, and place your feet and knees tightly together so you won't straddle a branch. Do not attempt to brake

your descent by grasping limbs; you are better off going all the way through to the ground slowly than ending up sitting in the top of the tree. Prepare for a PLF. If you come to rest short of the ground, check your position. If close, release from your harness and drop down. If you are up quite a way, relax and wait for help. Keep your helmet on until you have both feet firmly on the ground. Its purpose is to protect your head from takeoff to touchdown, and you aren't down yet.

If help does not arrive, you may have to climb down yourself. Perhaps you are way off the DZ and dusk is approaching. It's hard to shout continually, and it is nice to have a whistle in times like these. You may pop the reserve, let down the canopy and lines and then climb down hand over hand. If you let the narrow lines slip through your fingers and aren't wearing gloves, you will receive painful friction burns, so go hand over hand. If your reserve is round, be sure you are climbing down the *outside* of the canopy. Those who have made the mistake of not doing so have spent the night trapped inside a canopy dangling from a tree.

Water landings. There are two types of water jumps; those you plan and those you don't. An intentional water jump is an exciting, rewarding combination of aviation and water sports. But being unexpectedly blown out over the lake is cause for great concern. In fact, while few jumpers have perished in a planned water jump, 48 perished in unexpected water landings between 1967 and 1984. The figures are expected to improve now that the use of ram-air canopies has become universal.

Do not subject your main to an intentional water jump

The procedures for these two very different types of landings are not the same. In an *intentional* water landing, you will slide back in the saddle, undo the chest strap, belly band and one leg strap (unless you have a split saddle harness) and release the last leg snap upon splashing down. This procedure is also recommended if you find yourself being blown *unexpectedly* out over the ocean or other immense body of water. When there is absolutely no question that you are going for a dunking, you should get out of your gear, but this procedure should not be followed unless you are sure you are going in, planned or otherwise.

When making an intentional water jump, conditions are good, the jump is planned and the necessary flotation equipment is worn. The ingredients

for a life-threatening recipe are the unprepared and the unexpected.

The *Basic Safety Requirements* insist on the carrying of flotation gear when parachuting within one mile of any water deep enough to take a life, but there are times when one mile is not enough. A bad spot on a big load with high upper winds, sudden radical wind changes, a popped round reserve as you exit at twelve grand, for examples, may carry you far from the friendly DZ. And some water requires more protection than just flotation gear, such as when a jumper punches through the ice in the middle of a lake.

Most unintentional water landings are also unexpected. They take place in narrow rivers and small ponds, so small that one usually doesn't know for sure that he is going in until just a short distance from splash-down. There is no time to slide back in the saddle and undo the snaps, particularly if the jumper is trying to avoid trees at the time. As a result, he is going into the water in all his gear, and his chances are poor.

On the other hand, if he does go through the intentional water landing procedure *just in case* and then misses the water only to land in the trees because he couldn't spend enough time steering, he may fall out of his harness, subjecting himself to other dangers.

The greatest danger in water landings is becoming entangled in the net-like canopy and lines. In fact, we should think of: *panic, canopy, drowning*. All are problems and very much related and one leads to the other. If there is little wind in the small tree-

protected pond, the canopy will deflate and fall straight down on the jumper in a huge mess of tangled nylon fabric and lines. If he panics, he is sure to become caught in the trap. It seems logical, then, to try to avoid the canopy.

The procedure recommended for unintentional water landings is as follows: You are at 1,000 feet and the wind is backing you toward a water hazard. If you continue to face the wind, you may land short of it, and if you turn to run, you may land on the other side of it, but one thing is for sure: You will land in the vicinity of it. So, at double to triple the height of the trees, face into the wind to minimize your ground speed, pull your toggles to half brakes, and place your feet and knees firmly together.

—**Two Action System (TAS).** Continue to steer, activate your flotation gear if you have it and disconnect your main-reserve lanyard. Then just before touchdown, reach for the canopy release handle. At the moment your feet get wet, not one moment sooner, activate the releases. The tensioned canopy will recoil upwards and even a mild wind will carry it away. Altitude is very difficult to judge, especially over flat ground or a large body of water. One is always tempted to drop out of the harness *just before* touching down, but what appears to be just a *leg length* may really be building height.

This procedure will leave you floating with your harness and reserve on, but with the dangerous main canopy gone. Roll over on your back and take off the harness. Actually, the harness won't hurt or restrict you and the reserve will even provide positive flotation for a minute or so. In fact, the reserve

won't become negatively buoyant for about three minutes. So, use it for temporary flotation.

—Single Operation System (S.O.S.). With the S.O.S. system, you may jettison the main canopy but you are still attached to it with the Stevens lanyard, and the lanyard may activate the reserve. So, rather than activating the riser releases, undo your chest strap and belly band, activate your flotation gear, take a deep breath, enter the water and bend forward to get out of your leg straps as quickly as possible.

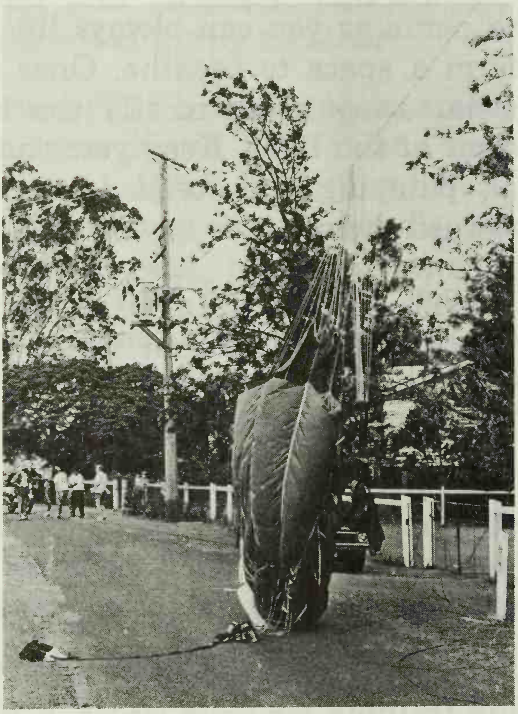
If the canopy does land on top of you anyway, grab it and *walk* a seam to the edge. There is no reason to panic as you can always lift the porous fabric to form a space to breathe. Once clear of the canopy, swim away using mostly the hands until you are clear of the lines. Keep your kicking to a minimum, as pumping legs tend to draw lines and fabric toward them.

If you should land in a river, even a slow moving one, you want to jettison your main as soon as possible. If it catches in the current it will drag you under and downstream, away from your rescuers.

Besides your reserve, certain other pieces of your gear may provide some flotation. Pneumatic soled jump boots, full shell helmets, knotted jumpsuits, etc., are all there for those who think to use them.

You must undergo (dry) unintentional water landing training for your USPA A license and (wet) live water training with full gear for the B license. These requirements have probably saved hundreds of lives so far.

Power lines. You must avoid power lines at all cost; the danger is just too great. Look for the high tension wires. If you are at an unfamiliar DZ, or land off target, look for poles. Wires run between them invisibly. Keep power lines continually in mind from the time you open so you can avoid them. High tension lines don't look dangerous, but they strike with the speed and power of lightning. They may electrocute you in an instant or put you in the hospital with severe burns; it isn't at all pleasant. If there is any question about clearing the lines, turn and run with the wind until you are past them. Be sure to make this decision high enough to give your canopy a chance to carry you away from danger.



Leave the canopy retrieval to the power company

If landing in the wires is inevitable, it is essential that you avoid touching more than one wire at a time. Any bird will tell you that it takes two wires to get zapped.

If you are going into the wires, face your canopy into the wind to minimize horizontal drift, pull half brakes, and make your final descent as close to vertical as possible. Drop your ripcord or anything else in your hands. Place your feet and knees firmly together with the toes pointed to avoid straddling a wire. Look for wires, and wriggle and squirm as necessary trying to avoid touching more than one at a time. If you come to rest near the ground, jettison the canopy quickly and get away. If you come to rest above jumping-down height, keep very still and wait for help. Any movement on your part may force an electrical contact. Warn would-be rescuers not to touch you or your gear until the power has been turned off. They could complete a circuit between you and the ground.

Once you get to the ground, be alert for broken powerlines. They are like snakes hidden in the grass and they not only strike, they sometimes start fires. Never pull on a canopy, attempting to remove it from the wires; it may be your very last good deed. Let the power company do it; it is their kind of work.

Other obstacles. There are many other landing obstacles which are potentially hazardous to parachutists, such as ditches, fences, hard roads and even some unique ones like hot water geysers. These hazards at your DZ will be pointed out to you in your first jump course, probably with a marked aerial photograph. When visiting a new drop zone, be sure to check in with an instructor or the Safety & Training Advisor for a briefing on their local hazards and recommended alternate landing areas.

When you are in the air, look for the danger areas. *Invisible* barbed wire runs between visible fence posts, powerlines run between power poles, isolated buildings are serviced by electricity. Power lines, ditches and fences often border roads, airplanes land on runways, etc. It is easy, but it is all new and the view is different: You are looking down at the terrain now, not horizontally.

If an obstacle presents itself, steer your canopy to avoid it. Turn your canopy to *run* and land beyond it, if necessary. If you are going to strike an object, hit it feet-first. Successful landings under a parachute are like those in an airplane: *the ones you walk away from are good*. It is far better to land outside the target area and walk back, than land on a fence and be carried back. Don't let *get home-itis* get you. If you pass over the obstacle very low, you may not have sufficient altitude to turn into the wind for landing. It is then preferable to crab the canopy slightly and try to do your best forward PLF. But, obviously, the best solution is to think and plan ahead to avoid the obstacle in the first place. The most important rule about landing hazards is: Continually make efforts to avoid them. The second rule is: It is better to land flying down-wind than to hit an obstacle.

Airport safety. Never smoke around aircraft, hangers or pumps. The combination of aviation fuel and aircraft dope presents a great fire risk. When moving light aircraft, be careful where you push. They are covered with very light fabric or metal and are easy to damage. The pilot will show you where it is safe to apply pressure.

Beware of the prop! It is difficult to see and will make quick mince meat of anyone who walks into it. Always walk around the back of fixed-wing aircraft and in front of helicopters. Stand where the taxiing pilot can see you; his forward visibility is not good. Get into the habit. Leave the dog and the children at home. The airport is not a nursery.

If your airport has more than one runway, stay off the *active* one. It will normally be the one running the closest to the direction of the wind. Remember that planes usually take off and land into the wind and look for them up there. Rules change from airport to airport, and at some you will not even be allowed to cross the active runway. Do not walk down any runway, and do not fly your canopy over one under 500 feet.

Be nice to the pilots, they have a lot of clout at the airport and you may need one to fly the jumpship. Be patient with the whuffos (spectators), they *are* public opinion.

UNITED STATES PARACHUTE ASSOCIATION PUBLICATIONS

Basic Safety Requirements

Note: Some small portions of these BSRs will not take effect until January 1, 1990.

2-1.01 Applicability

A. These procedures apply to all jumps except those made under military orders and those made because of inflight emergencies. Voluntary compliance with these procedures will protect the best interests of both the participants and the general public.

B. A "skydive" is defined as the descent of a person to the surface from an aircraft in flight when he/she uses or intends to use a parachute during all or part of that descent.

C. All persons participating in skydiving should be familiar with:

1. Section 2-1, USPA Publications (these regulations);

2. Section 2-2, USPA Publications (Waivers to the BSRs);

3. Section 3-1, USPA Publications (USPA Licenses);

4. USPA Recommendations; and

6. All Federal, State and local regulations and rules pertaining to skydiving.

2-1.11 Compliance with Regulations.

No skydive shall be made in violation of Federal Aviation Administration (FAA) regulations.

2-1.13 Medical Requirements

All persons engaging in skydiving should:

a. Carry a valid Class I, II or III Federal Aviation Administration Medical Certificate; or

b. Carry a certificate of physical fitness for skydiving from a registered physician; or

c. Have completed the USPA recommended medical certificate.

2.1.15 Age Requirements

Civilian skydivers are to be at least:

A. the age of legal majority (to execute contracts); or

B. 16 years of age with notarized parental or guardian consent.

2-1.21 Student Skydivers

A. All student instruction is to be under the supervision of a currently and appropriately rated USPA Instructor.

B. All student skydives are to be made under the direct supervision of a currently and appropriately rated USPA Jumpmaster aboard the aircraft until the student has been cleared by a USPA Instructor to jumpmaster himself. Accelerated Freefall students on levels I, II, or III require two currently rated USPA AFF Jumpmasters to accompany the student in freefall. All jumps on levels IV through VII require at least one USPA AFF Jumpmaster to accompany the student in freefall.

C. Student skydivers are to:

1. Initially make five (5) static line and/or tandem jumps to include successfully pulling a practice ripcord on three (3) successive jumps while demonstrating the ability to maintain stability and control prior to being cleared for freefall; OR

2. Successfully complete all learning objectives of Accelerated Freefall Levels I through VII prior to being cleared to jump without direct supervision.

D. Maximum ground winds for all student skydivers are 14 mph. Maximum ground winds for licensed skydivers are unlimited.

2-1.23 Minimum Opening Altitudes

Minimum container opening altitudes above the ground for skydivers are:

A. Tandem jumps—4000 feet AGL.

B. All freefall students—3000 feet AGL.

C. All static line jumps—2800 feet AGL.

D. A and B license holders—2500 feet AGL.

E. C and D license holders—2000 feet AGL.

2-1.25 Drop Zone Requirements

A. Areas used for skydiving should be unobstructed, with the following minimum radial distances to the nearest hazard:

1. Student: 100 meters. (With ground to air communication to assist student in canopy control.)

2. Class A License holders: 100 meters.

3. Class B License holders: 50 meters.

4. Class C License holders: 50 meters.

5. Class D License holders: Unlimited.

B. Hazards are defined as telephone and power lines, towers, buildings, open bodies of water, highways, automobiles, and clusters of trees covering more than 3000 square meters.

C. Manned ground-to-air communications (e.g., radios, panels, smoke, lights) are to be present on the drop zone during skydiving operations.

2-1.27 Pre-Jump Requirements

The appropriate altitude and surface winds are to be determined prior to conducting any skydive.

2-1.29 Extraordinary Parachute Jumps

A. Night, water and demonstration jumps are to be performed only with the advice of the local USPA S&TA or Instructor/Examiner.

B. Pre-planned breakaway jumps are to be made only by Class C and Class D license holders using FAA TSOed equipment.

2-1.31 Parachute Equipment

A. Each skydiver is to be equipped with:

1. Flotation gear when the intended exit point, opening point or landing point of a skydiver is within one mile of an open body of water (an open body of water is defined as one in which a skydiver could drown);

2. A light when performing night jumps;

B. Each student is to be equipped with:

1. A rigid helmet (except tandem students);

2. A piggyback harness/container system that includes a single point riser release, and a reserve static line.

3. A visually accessible altimeter;

4. An automatic activation device (AAD) (except tandem students);

5. A ram-air main canopy suitable for student use;

6. A steerable reserve canopy appropriate to the student's weight.

C. For each AFF jump:

1. Each student is to be equipped with a ripcord activated, spring loaded pilot chute equipped main parachute.

2. Each AFF jumpmaster is to be equipped with a visually accessible altimeter.

2-1.41 Special Altitude equipment, Supplementary Oxygen

Supplementary oxygen is mandatory on skydives made from over 15,000 feet (MSL).

Skydiving Rules of the Air

These right-of-way rules are extracted from Federal Air Regulation Part 91, *General Operating and Flight Rules* (shown here in regular type). They are further explained as they apply to freefalling skydivers and gliding parachutes (shown here in **bold** type). These are the general rules; local rules may be different.

91.67 Right-of-way rules, except water operations.

(a) *General.* When weather conditions permit, regardless of whether an operation is conducted under *Instrument Flight Rules* or *Visual Flight Rules*, vigilance shall be maintained by each person operating an aircraft so as to *see and avoid* other aircraft in compliance with this section. When a rule of this section gives another aircraft the right of way, he shall give way to that aircraft and may not pass over, under, or ahead of it, unless well clear.

(b) *In distress.* An aircraft in distress has the right of way over all other air traffic.

(1) A reserve canopy has the right-of-way over all main canopies.

(c) *Converging.* When aircraft of the same category are converging at approximately the same altitude (except head-on, or nearly so) the aircraft to the other's right has the right of way.

(1) The canopy (on your level) to your right has the right of way.

If the aircraft are of different categories—

(1) A balloon has the right of way over any other category aircraft;

(2) A glider has the right of way over an airship, airplane or rotorcraft; and

(3) An airship has the right of way over an airplane or rotorcraft.

However, an aircraft towing or refueling other aircraft has the right of way over all other engine-driven aircraft.

(1) The less-maneuverable aircraft has the right of way over the more-maneuverable. A balloon would have the right of way over a parachute and a parachute would have the right of way over sailplanes, hang gliders, airships, airplanes and rotorcraft, in that order.

(2) A tandem pair has right of way over a solo jumper both in freefall and under the canopy.

(3) A cameraperson has the right of way over solo jumpers both in freefall and under the canopy.

(4) A less-maneuverable round canopy has the right of way over a square.

(5) Students have the right of way over experienced jumpers.

(d) *Approaching head-on.* When aircraft are approaching each other head-on, or nearly so, each pilot of each aircraft shall alter course to the right.

(1) Approach other freefalling skydiver(s) slightly to the right. If you misjudge the closing speed, you will miss the formation or jumper.

(2) Canopies approaching each other head-on should turn right to pass. If you find yourself heading for another canopy after opening, veer to the right. If you cannot avoid a collision, spread your arms and legs to avoid going through the lines.

(e) *Overtaking.* Each aircraft that is being overtaken has the right of way and each pilot of an overtaking aircraft shall alter course to the right to pass well clear.

(1) Pass other freefalling skydivers to the right.

(2) Pass other canopies to the right. Avoid turbulent air behind and above other canopies.

(f) *Landing.* Aircraft, while on final approach to land, or while landing, have the right of way over other aircraft in flight or operating on the surface. When two or more aircraft are approaching an airport for the purpose of landing, the aircraft at the lower altitude has the right of way, but it shall not take advantage of this rule to cut in front of another which is on final approach to land, or to overtake that aircraft.

Remember that it is easier to see below you than above you.

(1) In freefall, the lower person has the right-of-way. If someone is flying under you, especially at pull time, it is your responsibility to move away.

(2) Anyone in the process of opening has the right-of-way. A wave-off is a signal that the skydiver is about to pull.

(3) Under the canopy, the lower canopy has the right-of-way. Give way to the lower canopy at altitude and near the ground. Lower canopies should not make hook turns in front of other canopies on final approach. If you are the low canopy, do not assume others see you. Shout to let them know you are there.

(4) Approach the target in a left-hand pattern unless local rules dictate otherwise.

(5) After landing, clear the target immediately for the next canopy.

(g) *Inapplicability.* This section does not apply to the operation of an aircraft on water. (See 91.69).

Chapter Five

Your Freefall Progression

Your progression after the first jump will depend upon whether you enrolled in the static-line program, accelerated freefall system or made tandem jumps. AFF and tandem took hold in the 80s, and toward the end of the decade the static line program was accelerated too. It used to take a minimum of 24 jumps in the static-line program to progress to 60-second delays; now it is possible to make them after just 15.

Since tandem jumps may be substituted for initial static-line jump training, we will only discuss static-line jumping and then will follow with an outline of progression in AFF. Later we will cover more advanced flying techniques.

Each static-line or AFF lesson is a phase of instruction. Each lesson includes five basic skill areas:

Equipment Preparation, Performance Preparation, In Flight (the ride in the aircraft), Freefall, and Canopy Control/Landing. Each phase expands and builds upon the knowledge and skills required of each previous jump, so correct performance is required for advancement to the next phase. Your instruction will come from a certified instructor with a static-line or AFF rating and each of your jumps will be directly supervised by a certified jumpmaster (or instructor) with a static-line or AFF rating until you no longer require formal instruction.

Static-line progression. After your first jump, your introduction to sport parachuting, you will make more static-line jumps, a minimum of five in all, before being advanced to freefall. In some countries 20 or 30 *rope* jumps are required to assure the student will pull the ripcord once on freefall, but in North America we have always required just five. The smaller number has not only proven sufficient, it is less apt to discourage the novice who is anxious to progress.

—Basic orientation (two jumps). The first two jumps are with a static line from 2,800 feet above ground level (AGL). On these jumps, you will demonstrate that you have learned how to control your main parachute, demonstrate the ability to distinguish between a good canopy, a partial malfunction and a total malfunction, and demonstrate emergency procedures, including the use of flotation equipment. You will show that you know how to move about the aircraft and get into the door, will demonstrate the proper sequence and body position to perform a stable, controlled exit, along with a verbal count and canopy check.

With the instructor, you will physically rehearse all routine phases of the planned jump and demonstrate proper responses to any emergencies that could occur during the flight or jump. You will be asked to identify the drop zone, target and wind sock from 2,000 feet or higher, as well as to point out the wind direction and explain your planned flight pattern. After exit, you will demonstrate the *spread stable body position* and you will look up to visually check your canopy within six seconds of exit.

Under the canopy, you will release your deployment brakes and follow the flight plan you established earlier while responding to directions from the ground crew. Your major turns will be performed above 500 feet. You will land in a clear area with your feet and knees together, prepared to perform a parachute landing fall (PLF). Immediately after landing, you will run to the downwind side of the canopy to avoid being dragged by the wind. Any jump not executed perfectly may have to be done over.

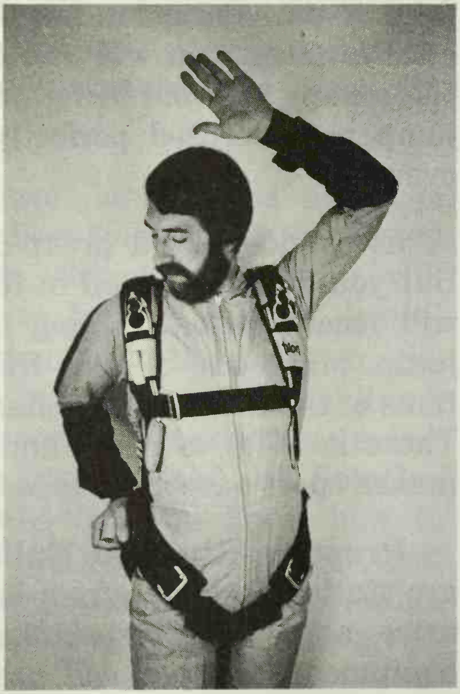
This sounds like a great deal to learn, and it is. But you will be trained in the first jump course and will receive more training prior to each succeeding jump. Make use of your free time by asking questions of the instructional staff and reading this book. There is a lot to learn and that is one thing that makes sport parachuting so interesting.

—**Practice RipCord Pulls** (three jumps). PRCPs are static-line jumps from 2,800 feet. You will learn more about the inspection and donning of your equipment, and you will use a horizontal trainer, a hammock-like device, to practice your stable face-to-

earth body position. On the horizontal trainer, you will practice the ARCH, LOOK, REACH, PULL sequence for pulling the practice ripcord. That sequence goes as follows:

ARCH THOUSAND: Arch hard. Your instructor may want you to assume an arched but not spread position. Your elbows are bent 90 degrees with your hands about a foot away from your ears. Throw your shoulders back (up) and arch hard so that your hands are higher than your head.

LOOK THOUSAND: Maintain your arch and look at the practice (dummy) handle. This is not as simple as it sounds as you are arching your back and pushing your head back (up) and away from the handle. Lower your chin and look down the side of your body.



On REACH THOUSAND, put your left hand over your head for stability

REACH THOUSAND: Maintain your arch and keep your eyes on the handle as you reach for it with your right hand. Simultaneously, move your left hand to a position over your head with the palm open and parallel to the ground. The positioning of your left hand over the head is good practice as the extra drag will keep you from going head-down or turning during pull-time on longer jumps. See the full explanation later in this chapter.

PULL THOUSAND: Grasp the handle and pull it while keeping your eyes on it. Simultaneously, move your left hand back to the basic freefall position.

Then stow the practice handle out of the way by dropping it down the front of your jumpsuit. The objective of your three PRCP jumps is to demonstrate that you can do-it-yourself. You need three *consecutive* stable PRCP jumps in order to advance to freefall.

—**Jump and pull** (one jump). Your first one off the *dope rope* will be a *jump and pull* from 3,200 feet. It will go just like your static-line PRCP jumps except that this is one of your great parachuting milestones. You are on your own and you are going to do it yourself. You are looking forward to it.

Your major mission will be to demonstrate time awareness and stability. On a jump and pull (sometimes called *clear and pull* or *hop & pop*), you must pull the ripcord within five seconds of exit without losing stability or control, just as you did on your three excellent PRCP static-line jumps.

> *Just as planning prepares you mentally, ground practice helps your body get used to going through the motions.*

Your last static-line jump and your first freefall should be on the same day, so plan your weekend considering the number of jumps you plan to make. Most students make two per day, and three is the recommended limit. Sport parachuting requires a lot of ground preparation and is quite tiring so, unless you are jumping at a commercial center where they take care of the carrying and packing of the gear, you will probably find that three jumps take all day and wear you out. Experienced jumpers may make a dozen jumps in a day while doing their own packing, but most call it a day after five.

There is very little air time during your initial training, especially on static line and short delays, so you will only have time to perform your planned maneuver once. In fact, the jump is more of a test than a learning experience, so a lot of thought and practice on the ground are required. Use the training aids, think about what you plan to do on each jump and make dry runs over and over. With this approach you will progress faster because you will make fewer mistakes in the air. Quicker progress will provide you with a greater sense of accomplishment and you will have more fun. It is always nice to do well especially in an exciting new challenge such as sport parachuting.

After devoting a lot of time to your ground practice and mastering your jump and pull, you will be advanced to ten-second delays in order to start learning freefall techniques. You will be making a minimum of two each of 10-, 20- and 30-second delays and then three 45s. You will progress from each level to the next as soon as your jumpmaster is convinced you are ready. At each level, you will have

certain skills to master. During your first 15 jumps or so, you will have good days and some not so satisfying. While you enjoy a sense of accomplishment, some of these jumps are more work than fun. In fact, if you drop out of the sport prior to amassing 1,000 jumps and qualifying for your Gold Wings, it will most likely be at this time, very early in the game.

—**Ten-second delays** (2 jumps). Tens are made from 4,000 feet. Now your training is beginning to accelerate, and you are getting into real freefall. You are learning more about your gear and are packing it under supervision. In the air, you are demonstrating your ability to maintain a heading without varying more than 45 degrees to each side (90 degrees total) in the basic freefall or *frog* position (more on positions later in this chapter). You will be introduced to spotting, or selecting the exit point (see the discussion in the next chapter). You will pull at the proper altitude and then land within 50 meters (just under 55 yards) of the target.

On tens, you will become conscious of wind, noise and speed while you begin using your altimeter in freefall. The needle of the altimeter doesn't move much on a ten, so you will have to concentrate on your count.

Your exits are important on tens as you are still falling relatively slowly (*sub-terminal*) and have little air with which to work. The direction of your exit will determine your body attitude in the air; there isn't enough time or airspeed to correct for a bad exit.

—15-second delays (two jumps). Fifteens start at 5,000 feet and provide you with real skydiving, entering the world of continuous *terminal velocity*. Terminal is the greatest speed at which you can fall through the air in a given body position, in this case, the arch. The resistance to the air (your size) overcomes the pull of gravity (your weight) until they balance out at about the ninth second after exit. In the spread, stable face-to-earth position this will be about 110 mph. This speed provides more control than you had on your sub-terminal jumps so you will find your maneuvers to be surer and quicker. On 15s, you fall quite a way prior to pull, and your jumpmaster may not be able to follow all of your airwork, so he may elect to exit after you for a closer view. You will be more relaxed in basic freefall position and won't be buffeting; you will be in control.

On 15s, you will begin checking your own equipment prior to exit, under the watchful eye of your jumpmaster, of course. You will exit the aircraft and hold a heading for five seconds and then perform slow, controlled 180- and 360-degree turns in opposite directions. Using your altimeter, you will demonstrate altitude awareness by pulling at the proper altitude. You will be expected to fly your canopy to land within 50 meters of the target center without ground supervision.

Any deviation from the horizontal plane is just plain poison for most people. Everybody likes to go fast and do things but, for some obscure reason, their ingrained fear of doing it straight down still persists.

—30-second delays (two jumps). Thirties are made from 7,500 feet above the ground and you will be flying in relation to other freefalling parachutists—*relative work*. You will make *door exits*, *figure eights* (two alternate 360-degree turns), practice the *delta* position and perform *backloops*.

The real excitement will come with relative work when you hold stable as *base* for your first *hook-up*. You will learn to wave off, prior to pulling. Experienced jumpers always wave off to alert any other skydiver who might be above them that a parachute is about to be deployed. You will also learn how to brief the pilot on the plan of the jump. On 30s you will be flying your canopy to land within 25 meters of the target center.

—45-second delays (three jumps). On these jumps from 9,500 feet, you will learn front loops and barrel rolls as well as how to hook-up with your jumpmaster, turn and then re-dock. You will be briefing the pilot on the jump plan, spotting without assistance and checking your own equipment prior to exit. Now, after relative work, you will be turning 180 degrees, *tracking* away, waving off and pulling.

By now you have at least 15 jumps. You have mastered most of the basics and are ready to make 60-second delayed falls. Start working for your Basic Skydiver, USPA A License.

Accelerated FreeFall. If you are in the accelerated freefall (AFF) program, you will start freefalling at terminal speeds and skip the shorter delays of the static-line program. Of course, your instruction and equipment will be different too.

The AFF program is divided into seven levels of progression. You will make a minimum of one jump at each level. Exits will be at 9,000 feet or higher with a certified AFF jumpmaster or instructor on each side holding on to you. Since instruction is on an individual basis, it may be customized to your background and needs. AFF teaches the fundamentals of skydiving in a logical order, beginning with basic survival skills and progressing through basic maneuvering skills. The object is to teach you all the basics and graduate you to the recreational level of skydiving.

In AFF training, your first-jump course is different from the static-line course, and a good deal of time is spent on practicing the exit. A good exit is required for a good freefall body position, and a stable exit is particularly important because there are three of you leaving the plane together.

—**Level I - Free arm**. Prior to your jump, you will learn how the parachute deploys as well as how to distinguish between a good canopy, a partial malfunction and a total malfunction. Your instructor will ask you to demonstrate the proper reserve procedure for each type of malfunction, as well as how to use your flotation equipment. You will show that you know how to move about the aircraft and into position to exit. From 2,000 feet or higher, you will identify the drop zone, target, wind sock and the direction of the wind, and will explain your planned canopy flight pattern.

You will exit the aircraft with a jumpmaster holding on to each side of you throughout the jump. They will release their grips on your arms or take high shoulder grips so that you may practice your

ripcord pulls. The jumpmaster on your left side is called the *reserve-side* or *secondary* jumpmaster, while the one on your right is the *main-side* or *primary* jumpmaster. The freefall training portion of this jump includes a *circle of awareness*, three practice ripcord pulls, another circle of awareness and altitude awareness down to the assigned pull altitude, which is normally 4,000 feet. A *circle of awareness* involves checking the ground for heading and altitude, checking the altimeter for an altitude reading, then your left-side jumpmaster and finally your right-side jumpmaster. Think GASP for Ground, Altimeter, Secondary, Primary. Each time you check a jumpmaster, he or she will inspect your body position and then confirm with a nod.

On opening, you will check your canopy, release the deployment brakes and establish steering control. Your flight pattern and ground control will lead you to the target area, and you will make your landing in a clear area. Major turns will be made no lower than 500 feet. You will land with your feet and knees together, prepared to perform a PLF and immediately after landing, you will run to the down wind side of the canopy to avoid being dragged by the wind.

—Level II - Body awareness. The purpose of your Level II jump is to further develop your body awareness and control, in order to prepare you for the jumpmaster release to solo flight that should occur on Level III. You will perform turns with your jumpmasters still holding on to you. They will make sure you remain stable and help you if you have problems. These trim control exercises allow you to get the feel of the air. Your jumpmasters may ask

you to move your arms forward and backward to demonstrate how these maneuvers make you go head-up, head-down or change your rate of fall. In Level II, you will learn to inspect your equipment as you put it on and will practice your stable, face-to earth body position in a horizontal trainer. Your ripcord practice will be the same as a PRCP on Level I. During the ride up, you will call out the altitudes and point out the landmarks to your jumpmasters. When you pull, you will watch the pilot chute begin to deploy your main canopy. If your canopy control is good and you have a minimum of horizontal drift, you may stand up on landing.

—**Level III - Release dive.** Your Level III dive will be one of the most exciting ones you will make while on student status. Your jumpmasters will release you to fly by yourself. Now you will be maintaining your heading, and falling in a relaxed freefall position. If you are demonstrating good body position and maintaining awareness, your jumpmasters will release their holds on you by 6,000 feet. They will remain nearby to assist you in maintaining a heading, a balanced body position and altitude awareness. You will deploy your own main parachute above 3,000 feet.

—**Level IV - Turns to redock.** On Level IV you will work with your jumpmasters on spotting and will learn about relative work. In freefall you will make controlled turns and forward movement. Your canopy flying will be better and you will be expected to land within 50 meters of the center of the target.

—**Level V - Turns to redock.** By now you are flying better; you have control of all three axes and are more relaxed. You have amassed almost three

minutes of freefall time and you are skydiving! Selecting the exit point is fun, and you are learning to check your own equipment prior to putting it on, and again prior to exit. This will be your first jump with a single jumpmaster. He or she will exit on one side of you and then *grip-switch* to hold your hands and fly with you face-to-face. In freefall, you will let go, make controlled turns and cover more horizontal distance to redock with your jumpmaster.

—**Level VI - Solo exit** is the big one. This is the first time you make a solo poised exit without assistance from your jumpmaster. You are controlling your heading prior to terminal velocity. You are learning to pack, you can brief the pilot on the jump plan and you are trying backloops and the delta position. You are tracking and waving off prior to the pull. By now you are expected to land within 25 meters of the target.

—**Level VII - Graduation dive.** Starting with a *door exit*, you dive out head-first, practice a front loop, perform a series of linked maneuvers (right turn, left turn, backloop), track away from your jumpmaster, wave off and pull.

That's it. You did it! By now you have at least seven jumps, have mastered most of the basic survival skills, are qualified to skydive without jumpmasters and are ready for solo jumps. Now it is time to start working toward your Basic Skydiver, USPA A License.

Supervision. All of your jumps will be made under the direct supervision of a USPA rated jumpmaster until your instructor is satisfied that you can take care of yourself and signs you off as

being *off instruction*. This isn't the end of your learning, it is just the end of your *direct supervision*. Once you have been certified as capable of jumpmastering yourself, you will be allowed to board the jumpship without a jumpmaster in tow and may even jump from a small two-place plane carrying just you and the pilot.

Now is the time to start studying for the written exam for the USPA A license. The Class A is like a driver's license. Once you get it, you are on your own. When you travel to other drop zones, you can show your license to prove that you know what you are doing. See Chapter Nine for the USPA A license requirements.

The Class A license is another great milestone in your parachuting career and a time to celebrate. Now you may take part in your jumping future, which is unlimited. Your relative work jumping will become more and more exciting as the number of people in the air with you increases. This is where the fun really begins in parachuting; this is what makes the first 20 jumps worth all the hard learning. Now let's get down to the specifics of skydiving.

Ripcord pulls. You will probably become more sensitive to the pull time as you progress up the delay ladder. During your static-lines and early delays, you will leave the step in a poised exit almost standing head-up. Later as you approach terminal velocity (after nine seconds), your head will drop more until your body is parallel to the ground and your airwork will become more important than your exit. Now, for the first time, you will have the time and air resistance to make bodily corrections. Stability, especially in *pitch* (head up-down), will be

much more noticeable. If you go head down on the pull, you will probably find it terribly unnerving and on the next jump you won't be looking forward to this part of freefall. And, you may find yourself counting down and making a quick grab for the handle in order to avoid going head-down. There are easier, more satisfactory ways to combat the problem.

—**Position.** The best approach to pulling the main involves reaching for the main ripcord handle with the right hand while bringing the left hand over the head as you were taught on your PRCP jumps. This method not only counteracts the tendency to go head down, it will allow you to correct any problems in the other axes (turns and rolls). If you can think to bend the legs at the knees a little more at the time you come in to pull, you won't go head down and the pull will be a very satisfying one.

—**Look**. Some students have trouble locating the main ripcord handle. Every piece of rental or club gear is adjusted a little differently; you can't expect the handle to be in exactly the same place every time. It is, therefore, essential that you look for the handle prior to reaching for it. The technique is to push the head back (to help you arch) while bringing the chin down to the chest and lowering the eyes to visually locate the handle. Depending upon the location of the handle, it may also help to turn the chin to the side. Look at the ripcord and you won't miss it when you reach for it with your hand.

*When the people look like ants—**pull**, when the ants look like people—**pray**.*

—Wave off. Soon you will be waving your hands by crossing your arms over your head. This is a *wave off*, which you are practicing for use on your relative jumps. It is a signal to those above you that you are about to pull.

Eyeball the ground. Learn what 2,500' looks like.

Altimeters are mechanical and, though they may be relied upon most of the time, are subject to failure. Learn to *eyeball* the terrain, learn what 2,500 feet looks like so you will recognize it the next time you encounter it.

Distance Fallen Each Second to Terminal Velocity

Seconds From Exit	Meters per Second	Feet Per Second	KMS Per Hour	Miles Per Hour
1	4.8	16	17.5	10.91
2	14	46	50.4	31.36
3	23	76	83.3	51.81
4	31.5	104	114.0	70.91
5	38	124	136.0	84.54
6	42.5	138	151.4	94.09
7	45	148	162.4	100.91
8	47.5	156	171.1	106.36
9	49.5	163	178.8	111.14
10	51	167	183.2	113.86
11	52	171	187.6	116.59
12	53.5	176	190.9	118.64
each additional second	53.5	176	190.9	118.64

General Rule:
After terminal velocity is reached (9 seconds, depending on your weight & jumpsuit), it takes 5.7 seconds to free fall each 1000 feet

Cumulative Distance Fallen in Free Fall Spread Position

Second of free fall	Meters	Feet	Second of free fall	Meters	Feet
1	4.8	16	15	612.5	2010
2	19	62	20	884	2900
3	42	138	25	1150	3770
4	74	242	30	1415	4650
5	111.5	366	35	1685	5530
6	153.5	504	40	1955	6410
7	198.7	652	45	2220	7290
8	246.5	808	50	2490	8170
9	295.5	970	55	2760	9050
10	347.5	1140	60	3025	9930
11	399.5	1310	65	3295	10810
12	452.5	1485	70	3565	11690
13	506	1660	75	3830	12570
14	561	1840			

Recommended Exit Altitudes For Pack Opening of 2500' Above Drop Zone

Type of jump	Feet Above DZ	Meters Above DZ
Static line	2800	850
Clear & Pull	3000	915
5 sec delay	3000	915
7	3280	1000
10	3600	1100
15	4500	1400
20	5400	1650
25	6000	1800
30	6800	2100
40	8100	2450
45	8900	2700
50	9500	2900
60	11000	3350
75	13000	3950
90	15000	4550

Freefall tables

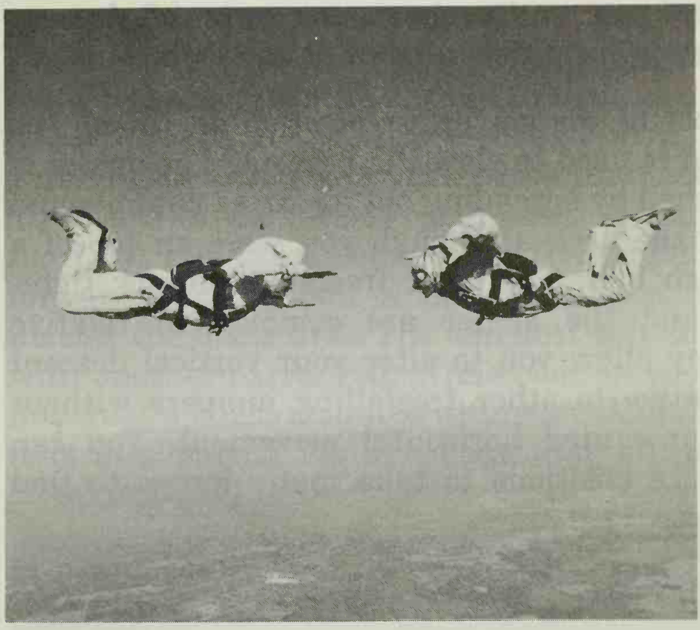
Speed. Distances fallen are calculated for freefall in a stable spread position with average temperature and pressure conditions for a sea level drop zone. The tables assume you are wearing about 30 pounds of equipment and a trim but not tight, jumpsuit providing a fall rate of about 115 mph or 170 feet per second. Also see the Conversion Table in Chapter Two. Caution, your rate of descent increases with (1) other body positions, (2) higher temperature, (3) lower pressure (e.g., higher field elevation). Use these tables with extreme caution at field elevations over 1,000 feet, especially during long delays. Tight jumpsuits will speed descent. A good rough rule of thumb is that the first 1,000 feet takes ten seconds and each 1,000 feet after that take five seconds.

Stability and body positions. *Stability* is a balance of forces. It occurs when you are falling in a selected position (e.g., face-to-earth) without requiring constant correcting movements. You are relaxed, at ease and not rotating on any axes. Because of the distribution of your body and parachute weight, it is difficult for novices to freefall for any length of time in a standing position, so we must select another acceptable comfortable alternative such as lying face-down. This position is familiar, easy to learn, allows a good field of view and gives you the feeling of flying like Superman. Other positions you could maintain easily are back-to-earth and the head-to-earth delta, but they can build up excess speed or be more disorienting. Using your arms and legs as control surfaces in the face-to-earth position, you can do most anything an airplane can do—except go back up.

Since we are trying to learn stability, it should be mentioned that it is possible to become unstable or *Z* (out of control). *Buffeting* (oscillating about one axis such as *pitch*; head up-down) can be corrected by relaxing and moving the arms back or in just a bit. Buffeting doesn't happen often and may not occur until you have several jumps, so the greatest problem may be in recognizing buffeting before the jump is over. Uncontrolled turns, slow or fast, are caused by unequal alignment of the legs, arms and/or trunk. Most students have no idea what their legs are doing because they can't see them; the legs must be in identical positions. If you go unstable at altitude, go ahead and attempt to correct it. If you are unstable at pull time or become disoriented, pull anyway. It is better to be stable during unpacking, but it is best to be unpacking regardless of position. At opening altitude, you are running out of time fast. Even if poor body position causes a malfunction, you are still slowed to about a tenth of your freefall rate of descent, so you will have more time to execute emergency procedures.

The spread stable position

The spread stable position or *cross* is the basic position for the beginning static-line program skydiver. The arms and legs are straight out and the back is arched hard to provide a shuttlecock shape.



The basic freefall position

The basic freefall position or *box* is a relaxed, stable, face-to-earth freefall position with a medium arch, with the legs bent upwards and the arms bent into a 90 degree or less U-shape. This position used to be called a *frog*. It is the common advanced flying position from which you will make all maneuvers. To practice the basic freefall position, start from the basic spread and then gradually relax it by bending the arms at the elbows and legs at the knees. Feel your way into it and make mirror image limb movements so as to maintain balance. You won't be able to watch your legs but you can keep your hands in view out of the corners of your eyes. If you relax at terminal velocity, your body will naturally flow into the basic freefall position.

The basic freefall position may be further modified by tightening it, especially at the shoulders and hips. Bend your knees more and move your elbows closer to your sides. Also try arching more and rolling your shoulders further back. Your reduced drag will cause you to increase your rate of descent without going head-down into a delta position.

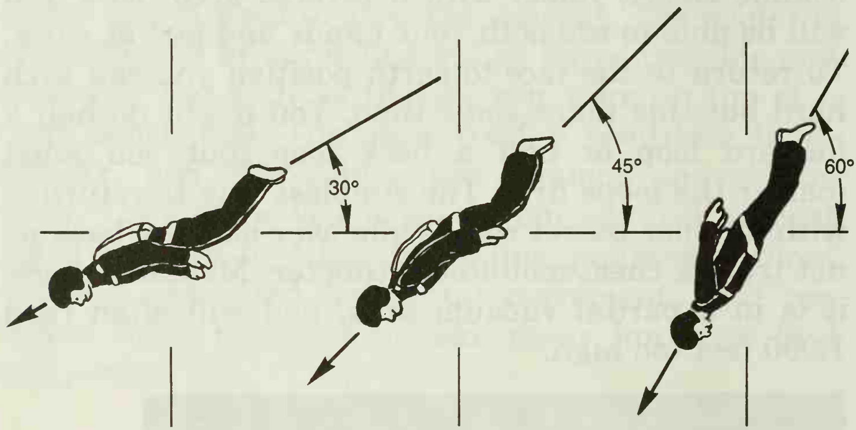
The opposite maneuver or position is called the *spider* and is used to slow the descent. The spider is accomplished by spreading out as far as possible and reversing the arch as though you were on top of a large beach ball. The basic freefall positions: tight, regular, and the spider are common in relative work. They allow you to alter your vertical descent speed relative to other freefalling jumpers without creating unwanted horizontal movement. You can expect these positions to take many jumps to find and perfect.

**The back to earth or *rocking chair* position.
Note the reversed arch.**

The stable back-to-earth position is a lot of fun and some jumpers can actually perform relative work this way. Getting over, holding it and getting back will provide you with the confidence that if you ever do find yourself out of visual contact with the ground, you can correct the situation. The easiest way to get over is with a barrel roll (discussed later in this chapter) and it is easy to maintain the SDB (Stable Delay, Back) with a reverse arch. Now you will be able to see both your hands and feet at work. To return to the face-to-earth position you can arch hard but this takes some time. You might do half a forward loop or half a back loop, but you must master the loops first. The simplest way to return is with another barrel roll. While over on your back do not trust a chest-mounted altimeter. Mounted there, it is in a partial vacuum area, and will often read 1,000 feet too high.

The delta position

The delta is a stable fall position with the head down providing a much increased descent rate. It is normally used in relative work to swoop down to the action. In the delta, the arms are swept back and maneuvering is done with the shoulders, hands and/or legs. The arms may be spread or tight against the sides and the legs may be spread or pressed together.

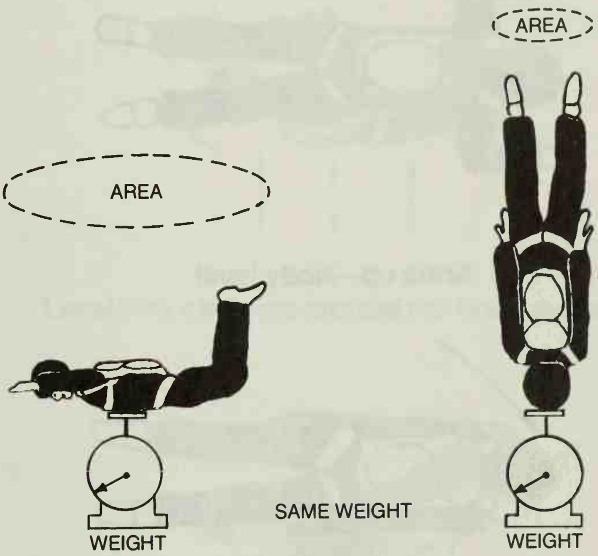


The angle of your delta is adjusted with the arms

Altitude and speed are two things to watch in the delta. You may accelerate from 110 mph in the face-to-earth basic freefall position to some 190 mph in a delta and this speed, plus the head-down body position, will make your opening something to remember. So, flare out to a stable spread position and slow down for a few seconds before dumping your main. Since you are eating up the altitude so much faster, you will want to keep an eye on the altimeter. A good, tight delta is a lot of fun; you can feel the great increase in speed as the wind pulls at your jumpsuit.

> *At pull time, you pull—regardless of body position.* - Mike Truffer

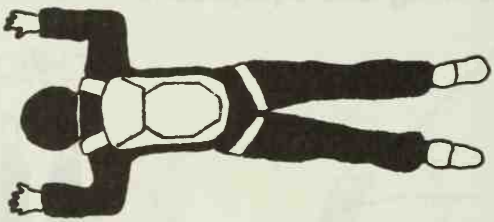
Vertical speed. With simple movements of body surfaces, the freefalling skydiver may increase and decrease his or her vertical speed, cover a significant amount of ground horizontally and perform every aerobatic maneuver as though suspended by invisible threads. This is true flying, the closest you will ever come to imitating the birds without large cumbersome wing-like equipment.



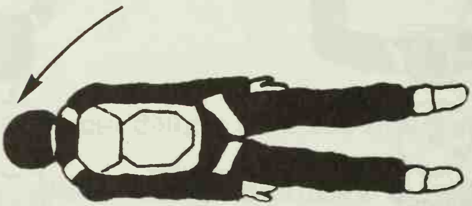
Your attitude does not change your weight but it does affect your drag and resulting air speed. As you alter your profile to the relative wind, you alter your air resistance (drag).

Short, fat people freefall faster at terminal than tall, skinny ones; your speed is easily noticeable by others around you in relative work. Your vertical speed in freefall is determined by your weight and your air resistance (drag). If you wish to fall faster, you must increase weight or decrease drag. Conversely, if you wish to fall slower, you must lose weight or get bigger in area. Relative work is flying, and doing so in relation to other fliers. In freefall it isn't

practical to add and shed weight so you are left with changing your drag area. Fortunately this is rather easy; by simply sweeping back your hands to drop your head into a delta position, you can increase your vertical speed by more than 50%.



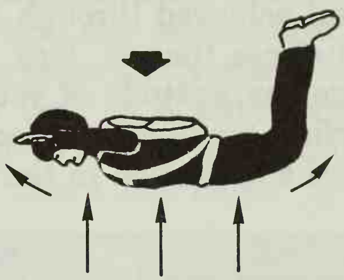
Arms up—body level



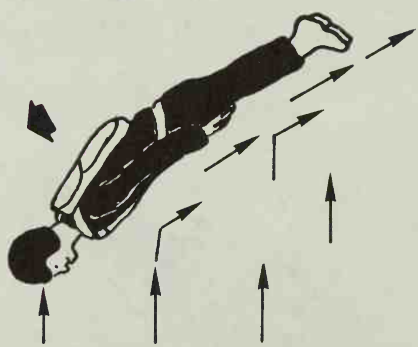
Arms back—head down

In the spread stable face-to-earth position, your body's weight is concentrated in the center and your limbs are both vanes and control surfaces, very much like an airplane. You are balanced with an equal amount of air resistance on your limbs all around your weight in the center. Now, if you move your hands and arms rearward, reducing the supporting drag on the upper part of your body, you will go into a head-down attitude. Or, if you put your hands straight up over your head and draw your

knees up to your chest, you will start into a back-loop. You can even turn (yaw axis) by simply dropping a shoulder, as this places a twist in the body so that it takes on a shape somewhat like a propeller. So, by altering your flying surfaces, you can perform most any aerobatic maneuver.



Level: the air flows around the body evenly



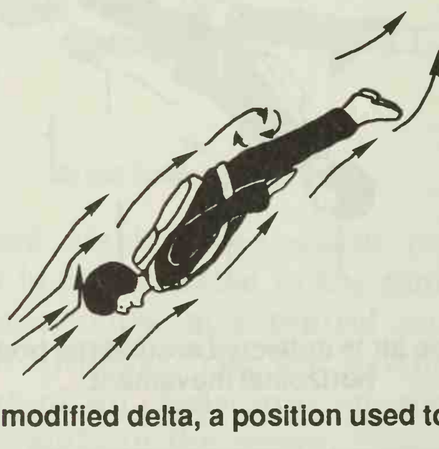
At an angle: the air is deflected around the body producing horizontal movement.

The air! Man has visions of flight—not the roaring progress of heavy sinking machines, but that silent loveliness of gliding on outstretched arms that comes to everyone in dreams. - Frank S. Stuart, *City of the Bees*

When you are freefalling in a face-to-earth position, your body plows through the air forcing it to flow evenly all around you. But when you angle your body, such as in a delta, the air is deflected and this imparts some horizontal movement; your body acts like a sled.

So, it can be seen that all your aerial maneuvers are initiated and achieved through the alteration of your control surfaces (hands, legs, etc.). These alterations change the attitude of your body, varying its effective surface area with respect to the relative wind, and causes a deflection in the air flowing past your body.

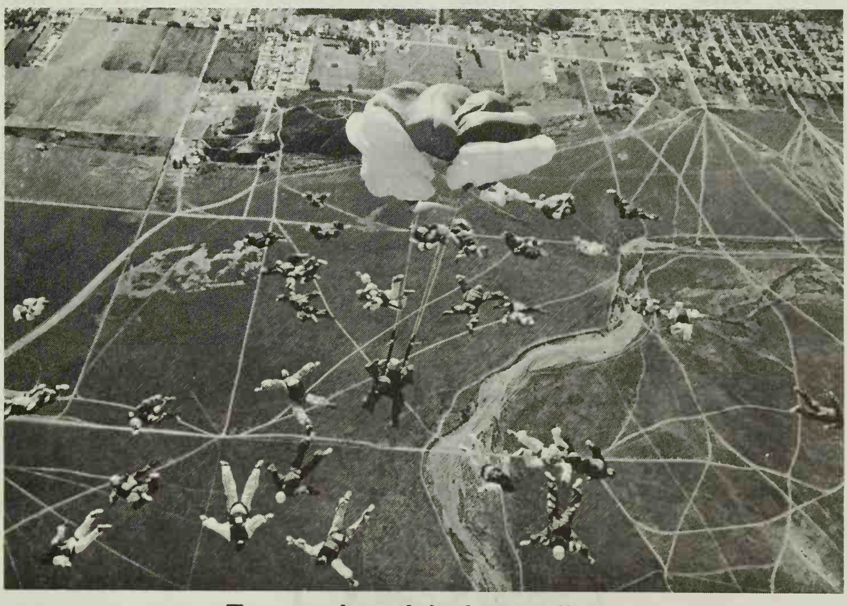
Once again, ground practice and review will increase your chances of success in the air. It helps to know what you are doing before you go up. If your DZ does not have a horizontal hammock-like training device, a lot of these maneuvers may be practiced on the floor, a small table or even a bar stool.



The track is a modified delta, a position used to cover ground

The track position is sometimes used by the parachutist who discovers he has erred in spotting or has drifted in freefall; he uses the track to get back to the opening point. Even more important, it

is used to *turn and track* when jumpers separate after relative work to achieve maximum horizontal separation for opening. The track is a further refined *delta* which forms the body into a rough airfoil like the profile of an airplane's wing. This position is designed to produce some lift, in addition to the force of the deflected air, to move the body through the air horizontally. It has been theorized that in a *max trac*k, one can achieve an angle of 35 degrees or more from the vertical, or approaching 1:1. This means that on a sixty second delay from 12,500' providing 10,000' of freefall, one could cover 7,000' of ground, that's 1.35 miles!

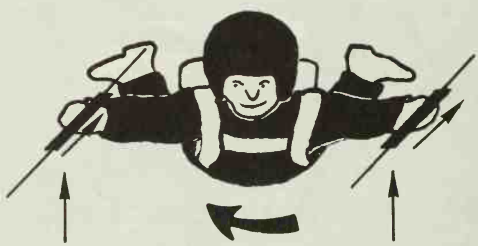


Turn and track before pulling

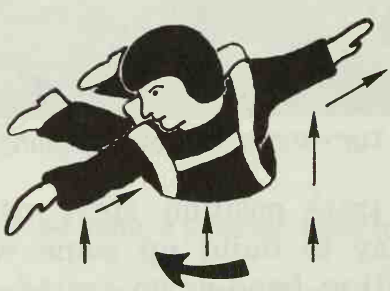
To learn the track position, start with a delta on a 45-second delay to build up some working speed. After accelerating head-down for 15 seconds, bend slightly at the waist, roll your shoulders forward, bend your arms to follow the body, cup your hands, force your head back, straighten your legs while

keeping them together and point your toes. You should be able to feel and see the difference but, remember, it takes time to build up speed so accelerate for 15 seconds and then get into position and hold it for 20 more. When you are really starting to develop lift, you will feel your dive flatten out quite a bit. The track can be steered by gently guiding with your arms, hands, shoulders or head. The track is not only fun, it is one of the most important positions. It should not only be tried, it must be mastered.

Turns are a movement about the vertical (yaw) axis and are the most elementary of your basic maneuvers.



Even minor tilting of the palms will cause a turn



To turn, twist your body like a propeller

If you can start a turn, you can stop a spin. - Ted Strong

When you are nine seconds out and falling at terminal velocity, you have a lot of *relative wind* (the wind or air striking your body) to work with, a lot of air to push on. From the basic freefall position, even angling both hands 45 degrees the same direction will produce a slow turn. Study this phenomenon on your next drive to the DZ by sticking your hand out the window of the car. At 55 mph, you are doing only half the speed of face-to-earth freefall but it is enough to demonstrate wind deflection. In freefall, your body is riding on a slick cushion of air. Very little pressure is required to make it turn.

There are many ways to effect a turn, in fact, the trick is in *not* turning. Any alteration in the position of your hands, arms, legs or body will produce a turn unless counteracted by another body part. Some of these specialized turns such as the *push turn* are used for certain types of jumps such as *style* competition. In turning, the twist is the trick. Turns are made in the same way from the basic freefall, delta or track positions; just lower a shoulder. In the basic freefall position, the hands and arms are lowered too.

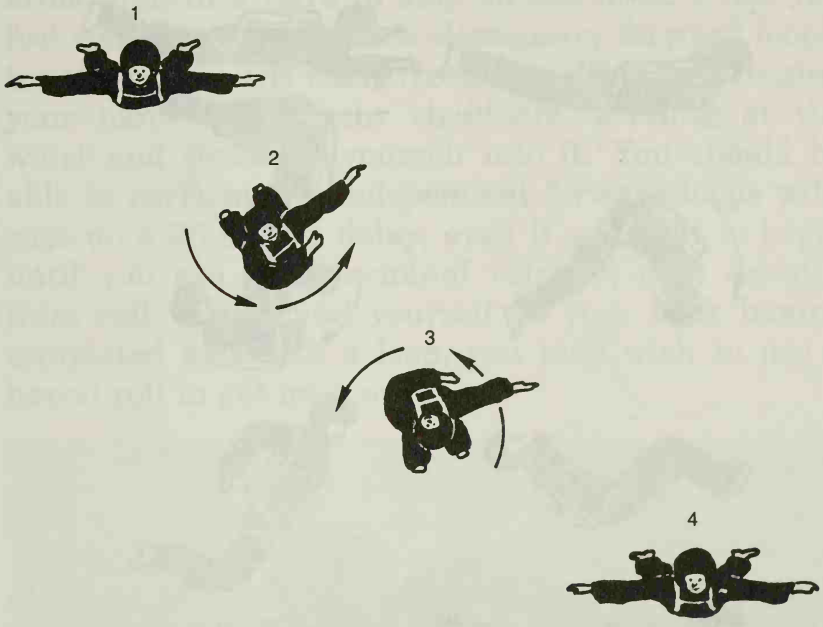
To learn natural turns, exit the aircraft, assume the basic freefall position and build up speed to near-terminal; turns will be sluggish if you start right off the step. Bring your hands back just a bit so you are very slightly head low then look in the direction you wish to go. Bend your head that direction and dip that hand and shoulder. Your body will follow your eyes. Soon, turns will become second nature, automatic. Like riding a bicycle or swimming, turns need not be deliberated over before every movement. In time, even stability will become auto-

matic. When moving an arm, one leg will compensate subconsciously. You won't even know it. To stop the turning, just straighten back to your basic freefall position. If you are turning fast, you may have to position yourself briefly for a turn in the opposite direction so as not to overshoot your heading.

Two 360 degree turns in opposite directions are combined and called a *figure eight*. Mastery of this maneuver is one of the requirements of the USPA A license.

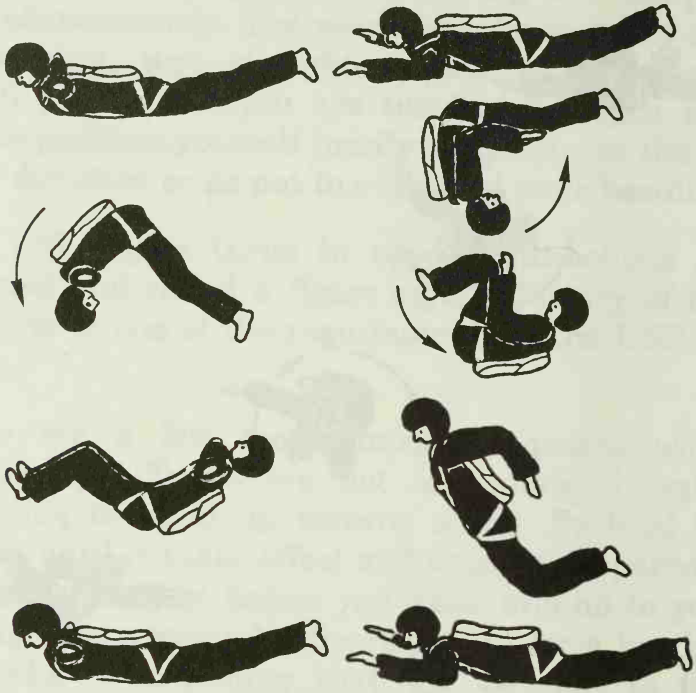
There are a few more important points worth remembering. Turns are not immediate; it takes some time to build up turning speed. So hold the position until it takes effect and then be prepared to stop your turn just before you come around to your heading. Use a ground reference point for a heading and make it something that will be easy to find when you come around. Remember that sub-terminal turns are slow and mushy, unlike the turns you will make after nine seconds out. If you should get into trouble practicing turns, and can't stop one with an opposite correcting turn, assume the delta position. Once straightened out, go back into the basic freefall position. You can always delta out of a spin. But remember to keep track of your altitude and pull at pull time whether you are stable or not.

The barrel roll should be one of your earliest aerobatic maneuvers because it is easy, not as potentially frightening as a front loop or back loop, will help you practice SDB (Stable Delay Back-to-earth) and mastery of it is good insurance in case you ever find yourself on your back unexpectedly.



The barrel roll

To make a barrel roll from the basic freefall position, spread out to a cross position. Straighten your legs and pull them almost together while sticking your arms straight out to the side. Then bring one arm in across the chest while dipping (rolling) that shoulder. The sudden loss of drag on that side of your body will cause it to drop, and roll you onto your back. To complete the roll, extend the folded arm and bring in the outstretched one. Then resume the spread-arm cross position as soon as the ground comes into view again. Do another roll with more coordination and it will be smoother. Once you feel confident about barrel rolls, try one from the basic freefall position and accelerate it by throwing your arm and shoulder under and into the roll. Because your arms are in, you will do the complete roll in an instant.



First forward loop Improved forward loop

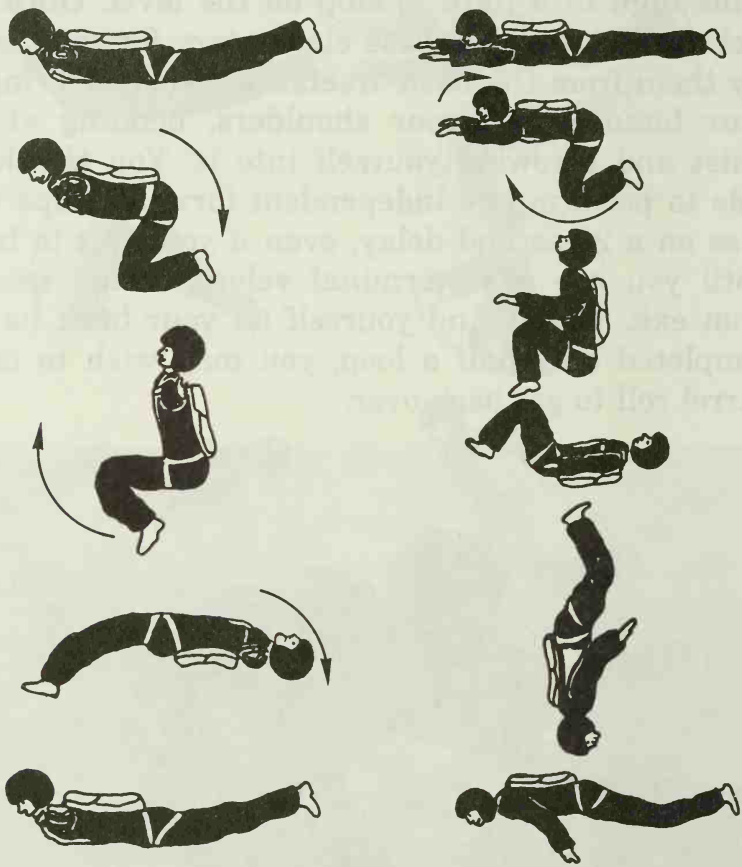
Forward loops are easy, though at first, going head down may make you a bit anxious. Just as we learned the barrel roll, we will start with a *safe and slow* method and then we will clean it up into an improved loop.

Assume a cross position. Extend your legs straight back and spread them just slightly. Then put your arms straight out. Your spread arms will give you lateral stability so you won't fall off to one side. Now simply bend way forward at the waist. The sudden loss of drag on the upper part of your body will cause your head to drop and you will go all the way around. When the ground comes into view again, straighten your body. You may wish to throw the

arms high in a flare to stop on the level. Once you feel confident about these elementary forward loops, try them from the basic freefall position by bringing your hands in to your shoulders, bending at the waist and throwing yourself into it. You should be able to perform two independent forward loops with ease on a 20-second delay, even if you wait to begin until you are near terminal velocity, nine seconds from exit. If you find yourself on your back having completed only half a loop, you may wish to use a barrel roll to get back over.

The backloop

The backloop is just like doing a gainer into a swimming pool but you don't have to worry about hitting your head on the diving board. First we will try the safe and slow method and then the improved loop.



First backloop

Improved backloop

Assume a cross position. Extend the legs straight back, spread just slightly. Then spread your arms straight out to the sides. This position will provide you with lateral stability so you won't fall off to the side. Now quickly bring your knees up to your chest. The sudden loss of drag on the lower part of your body will cause it to drop and you should go all the way over. When the ground comes into view again, straighten the body and flare. Once you feel confident about this elementary method, try the backloop from the basic freefall position. Simultaneously push

forward and down with your arms as you pull your knees up to your chest and throw back your head. The momentum should carry you all the way over. Flare when the ground comes into view again.

A sloppy or incomplete backloop may leave you on your back. A barrel roll is probably the easiest and fastest way to return to the familiar face-to-earth position should this happen.

Front loops and back loops are much easier out of an aircraft than off a diving board because you have more time and do not have to worry about entering the water at the right angle.

Other positions and maneuvers. There are other freefall positions and maneuvers such as the *style tuck, backslide, T, daffy, layout backloop, twist through, knee turn* and so on which you will want to attempt after mastering the above-mentioned basics. Once you can handle the above, all others will be easy.

The unpoised, door exit is a prerequisite to relative work

Door exits are a thrill. They are one of parachuting's training milestones and provide you with a great feeling of accomplishment. The satisfaction you will feel is equivalent to your first freefall and your first sighting of another jumper in the air. You must master the door exit as it is the last of the basic skills required for beginning relative work and for most skydivers, RW is what jumping is all about.

Now that you feel confident about your loops and rolls, you know you can recover if you should suddenly find yourself on your back. There is no reason to be apprehensive about an unpoised exit. There is no need to exit the aircraft face-to-earth, or even stable, as long as you are in complete, continual control.

Let's start with a warmup jump; a modified poised exit from a Cessna. Get in the door and when you are ready to go, reach for the strut with your left hand, put your left foot on the step and then just swing out and go. As you leave the step, your position is just like the old poised, stable one, but your right hand and right foot never make contact with the plane. This exit looks good and is a great confidence builder.

Now a real door exit; straight out perpendicular to the fuselage. Just dive out with your arms swept back, do a forward loop and flare. Nothing to it and it happens so fast! You might get flipped by the prop blast and relative wind, but it isn't likely because your profile is very small. You will be out of the prop blast by the time you flare out face-to-earth.

Next, try the same exit without the front loop. Once you clear the door, arch, throw your hands

high and bring your feet together to counteract the loop. (This looks like a Superman swoop.) Try some exits straight out and try some with turns into the direction of flight. Make corrections by adjusting your body position and avoid kicking or attempting corrections by throwing your body around. From large aircraft, dive back and down to minimize the effect of the prop blast. You will love door exits and will never go back to the poised type, except for some specialized, hanging-on group exits.

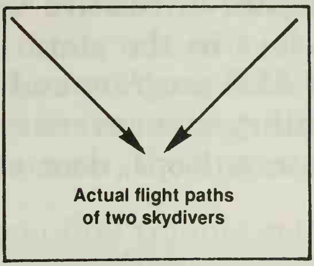
To practice for RW and be ready to learn big formation work, try exiting head-first and transitioning smoothly from the Superman swoop into a tight delta. Gradually move your hands and arms down close to your body and spread your legs about shoulder width. It will take several jumps to get the feel of this but you will use it a lot later.

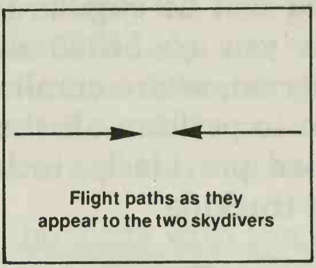
There are many things to do in the short time you have in freefall, so don't spend all of it on the exit. After leaving the aircraft, get on with your other air-work, canopy work, etc.

Relative work: group jumps

Relative work is the intentional maneuvering of two or more skydivers in close proximity to one another during freefall. Rapid precision freefall relative work is fun, fast, and exciting; there is something to learn and enjoy on every jump. RW is an activity that requires teamwork; it is a coordinated balancing act requiring maximum effort from each and every participant. The preparation is great while the flying time is short, and anyone in the air can blow the jump by taking out the fragile formation. When successful, relative work is an incomparable joy to be shared by all. Whereas relative work was once a hit-or-miss affair between two jumpers, it is now an exact aerodynamic science often involving 100 or more participants.

RW was born in 1958 when Lyle Hoffman and James Pearson made the first baton pass in Vancouver, BC. Later that year, Steve Snyder and Charlie Hillard made the first baton pass in the U.S. In subsequent years, the stick was abandoned but small *star* formations were being accomplished routinely. Size was usually held to four, the capacity of most jump planes. In 1965 at Taft, California, the *Arvin Good Guys* put the first 8-man together. Taft was also the site of the first 10-man in 1967, and the Center even hosted a 10-man competition later the same year. Credential type recognition also began that year when Bill Newell established the Star Crest and began issuing patches to those who had been in stars of eight or larger. In 1970, a 4-way RW event was added to the National Championships; it wasn't large star work, but it was RW. Ted Webster led an RW team to the 1970 World Championships in Bled, Yugoslavia, to make demonstration jumps, and this turned on the world!





Recognizing that many women participated in relative work, the term *man* soon gave way to *way*, as in 10-way event. A 10-way speed star event was introduced at the 1972 U.S. Nationals; interest in large star RW was booming. The Commission Internationale de Parachutisme accepted RW in 1973, and both 4-way and 10-way were now world-wide events. Interest soared! Equipment changed, big planes were located, jumpers drove great distances to get together to jump the big birds. Everyone was doing RW. Novices aspired to it and old timers learned something new; RW put the fun back into jumping. At the end of 1976 in Zephyrhills, Florida, over 100 10-way teams entered the annual meet. Through 1975 and '76, the large star interest turned to sequential RW; the plain old star was passe. Now they were doing snowflakes, accordions, donuts and even flying back-to-earth. When the CIP met in 1977, it adopted the 8-way sequential event for world competition. Then jumpers began doing the impossible: zipping around formations, crossing over other bodies intentionally and using the drop in the burble to position themselves. They made three-dimensional formations with one or more members standing up! It was incredible. RW is obviously limited only by the imagination.

All motion is relative to the observer. - Albert Einstein

You will be eligible to participate in relative work once you are on 30 second delays in the static-line program, or are enrolled in an AFF program and are able to perform all the elementary maneuvers mentioned previously, including turns, loops, door exits and tracking.

***Dirt dives* are used to plan RW jumps**

Pre-jump planning is even more important in RW than in solo leaps. When you are on your own, lousy flying hurts only you. In a group, mistakes may take out the formation or even cause injuries, and this is no way to make friends. Freefalling jumpers can collide in the air or one may open below the other. High speed collisions occur when one jumper stops (under an open canopy) and the other is still at terminal. So it pays to plan the jump.

> *The exultation of seeing fine relative work flying is surpassed only by the joy of being part of the jump yourself.* - Pat Works

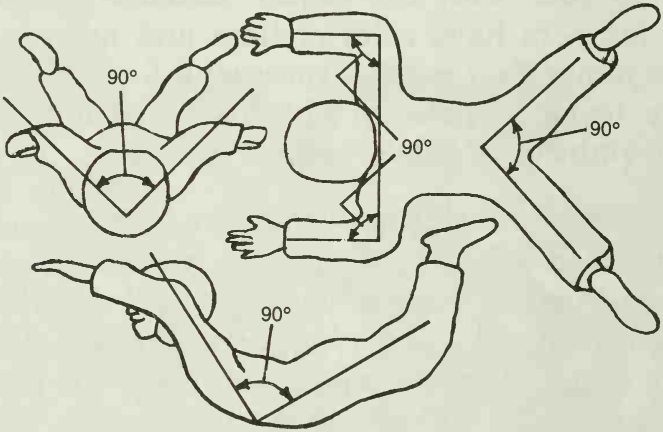
Your initial RW training will probably be with your instructor, one-on-one. He or she will help you with the basics. Your first hookup will be followed with practice in exits, dives, vertical and horizontal maneuvers, the approach, docking and the breakoff.

If you find trouble getting on the loads with the big guys, it's only because you are a novice and not yet ready to soar with the *eagles*. Remember that the other jumpers have a lot of time and money riding on the jump; they want a successful formation. They dislike being targets for the less experienced, and have a right to be selective.

You would probably only make a mistake and be embarrassed anyway, so develop your own skill by working in small groups. The best RW practice may be performed with just two participants. Solicit the help of a qualified RW instructor from your DZ staff. Often he or she will offer you a lesson for only the price of a lift ticket. Form your own 4-way *team* of big-load rejects and work together. Once you are making hookups consistently, switch the exit order. Is the link-up smooth? Can you do it sub-terminal? Six seconds out the door? Can you fly side-by-side without touching? Ask an *eagle* to coach your team. When you are good enough, when you have tried hard enough, the eagles will notice. Then *you* will have to remember to be kind to novices.

RW flying positions. Fall rate in relative work used to be controlled by adjusting the jumpsuit: pulling it in to go down and extending it to go up (relative to the other skydivers). During the *wing war* of the seventies, everyone wore huge jumpsuits with wings, vents and swoopcords. Today the teaching has changed and most jumpers are wearing

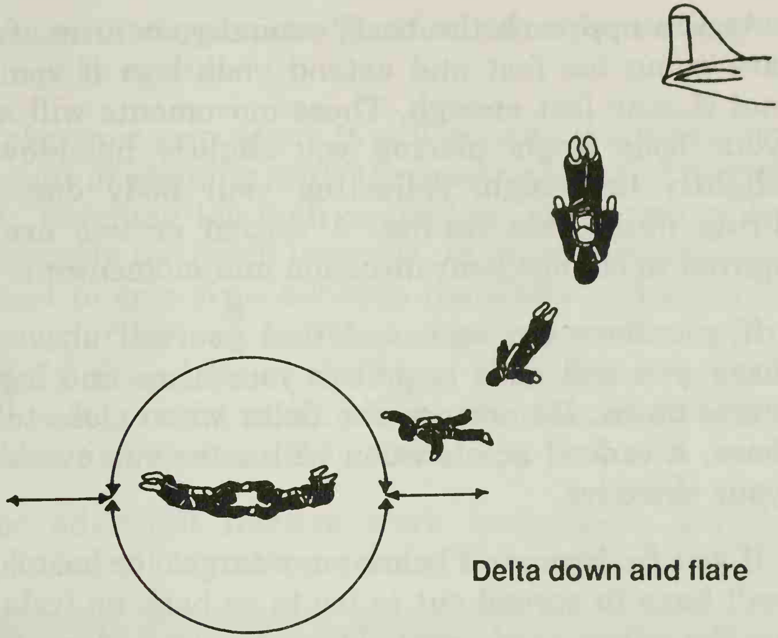
slicker, tighter jumpsuits. Everyone is falling faster, and fall rate is controlled though body shaping; the curve in the shoulders, hips and back. We fall faster by placing more curve in our back and we fall slower by straightening our body with the elbows and knees down slightly. Fall rate is a very important part of relative work and it seems to be difficult for new jumpers to master.



The boxman position

—The boxman position is a basic freefall position with 90 degree angles: Your back is arched 90 with your head up, your legs are spread 90, your arms are up 90, your elbows bent 90 and your knees are bent almost 90. You will have to do some stretching exercises to master this position in the air. Think about your body shape in freefall, relax and let your arms and legs blow back. Close-in maneuvering is done with slight torso movements, with the lower back and shoulders aided by small leg movements. Your hands and arms are used to dock but not to maneuver.

Many of the people asking to get on 10-way loads aren't capable of making consistent 2-ways. - Bob Iverson



Delta down and flare

—**Use the delta position** to close large vertical distances. If you are the last one to exit, you will have to get down to the *base* formation of one or more other jumpers. Sweep back your arms, press your legs together and aim toward your target. The farther the distance, the steeper your delta will be. Now think about *energy management*. You must delta to accelerate and move down as quickly as possible but you must slow down *before* you arrive at the level of your target. If you flare too soon, you will have to readjust to accelerate again. If you flare too late, you could collide with or overshoot the base. Perfecting your swoop through energy management takes practice. You must be fast when you are far from the formation and slow when you are close. You must perfect your timing and be smooth. So hold this tight delta until half-way to your objective and then slowly and smoothly relax the track by letting your legs and arms spread. Look, time, and adjust your descent to a smooth, gentle dock.

As you approach the base, extend your arms if you are going too fast and extend your legs if you are not closing fast enough. These movements will alter your body angle placing you slightly head-low or slightly head-high. Adjusting your body does not bring immediate results. A second or two are required to change your direction and momentum.

If you flare too soon and find yourself above the base, you will have to pull in your arms and legs to move down. Do not use the delta when close to the base. A radical acceleration will make you overshoot your objective.

If you find yourself below your target (or base), you will have to spread out to try to go back up (relative to the other skydivers). This is a bad place to be because forward movement usually means increased descent speed. It is also difficult to close on a target from below.

—Grip. When you reach your objective, you will hook-up or *dock* with a grip. This should be a *no-tension grip*, as though you and the base were flying in close proximity but not touching. Do not hang on a formation. The point is that the base is not a place to land and relax. You must join the formation—on level and actively fly your part of it.

Do not reach for a grip. Reaching down will make you float, while reaching up will probably disturb the person you grab or even make the whole formation slide. Do not carry any momentum when docking. Reaching out, gripping and pulling yourself in will move the base. Similarly, if you dock too hard, you will push the formation. These are simply cases

of action and reaction: The formation is reacting to your push or pull.

Make your grip where it will provide the maximum amount of stability with the least amount of disruption. Gripping too high or too low on an arm or leg may apply too much leverage. In large formations, it is best to grip arms between the elbow and shoulder so your *gripee* can use his or her lower arms to grip and fly. Grip legs at the knee. Gripping a foot will pull it downward which will put tension into the formation and/or cause it to slide.

For advanced relative work instruction, see the books listed in the Appendix of this book.

Tamara Koyn performs a Chinese Split

Freestyle skydiving consists of creative movements by one or more skydivers. The positions are limited only by the imagination. Freestylists are performing positions and movements we used to think were impossible, such as standing up, and

they are performing in synchronized groups. See the video tapes listed in the Appendix.

Continuing education. Skydiving is evolving so rapidly that there is always something new to learn; nobody knows it all. Once you finish the static-line course or the AFF course, you will want to progress to Level 8 to develop your freefall skills. See USPA's *Skydiver's Information Manual* for full details.

Anytime you lay off for more than 30 days between jumps, you will have to undergo refresher training and make a basic jump. For example, if you took the static-line training and do not have your Class A license, you will have to make a static-line jump. If you have your Class A license but not your B, you will have to make one clear and pull.

> *Every relative work dive should end the same way: Turn, track away, clear the air over your head, wave-off and pull.* - Bill Dause.

Chapter Six

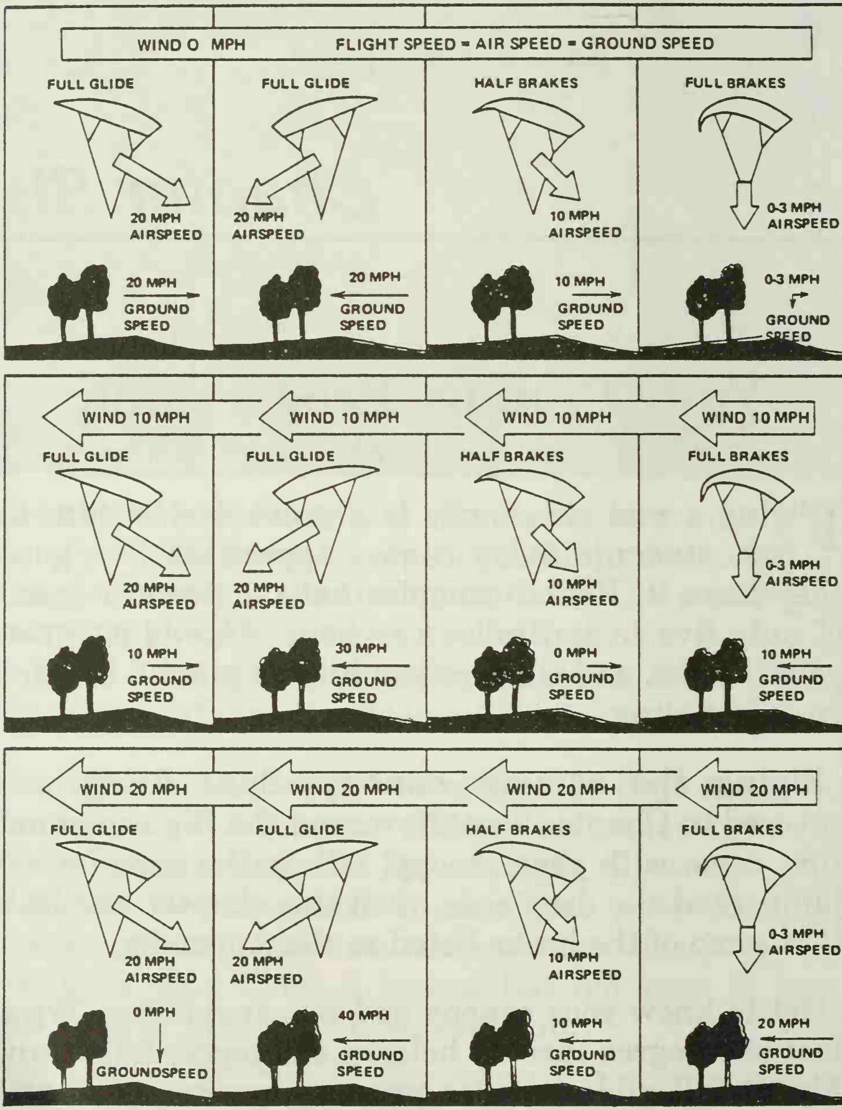
Your Canopy Progression

Flying a ram-air canopy is a great deal of fun. In fact, students today cannot appreciate how good they have it. Round canopies have a forward speed of only five to ten miles per hour, depending upon your weight, and they let you hit the ground so hard your feet sting.

Flying the ram-air canopy. Basic flying was covered in Chapter Two. Now read the flight manual that came with your canopy, talk to the experienced jumpers at the drop zone, read this chapter and look into some of the books listed in the Appendix.

Get to know your canopy and its capabilities. Try a fast 360-degree turn by holding one toggle full-down. Fly at full glide (toggles up), one-quarter, half and three-quarter brakes. Hold each position for several seconds and notice how the canopy slows down. Hold

both toggles at chest level and then let one up. This is a turn from half-brakes which will be flatter, slower, more stable and will lose less altitude. Canopy familiarization should be conducted above 2,000 feet and breakaway altitude. At 1,000 feet you should be in your landing pattern.



Airspeed verses ground speed and the ram-air canopy
Para-Flite drawings

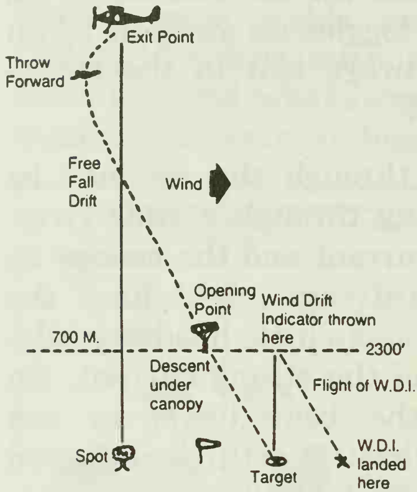
If you would like to check your angle of glide at each brake position, spit into the air and watch its angle of fall. Spit with the toggles up and spit again with the toggles down. Always spit to the side—never *into* the relative wind.

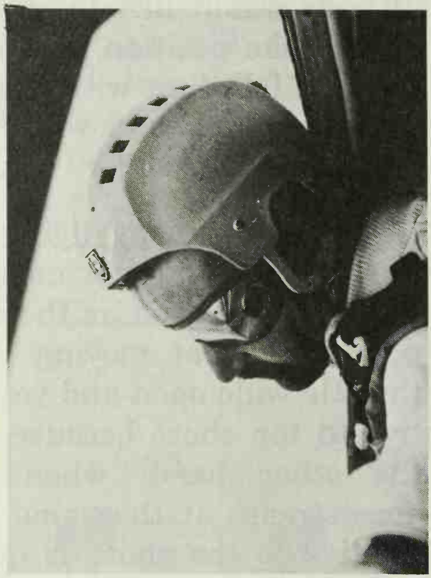
A ram-air canopy flying through the air may be thought of as a boat moving through a wide river. Think of the wind as the current and the canopy as a boat. A boat moving upstream might have the throttle wide open and yet make little headway relative to the shore because of the strong current. On the other hand, when the boat turns to run downstream at the same throttle setting, its speed relative to the shore is quite high. The same principle applies to parachute canopies holding against the wind or running with the wind.

Spotting is the selection of the course to fly on jump run, directing the pilot on that course and deciding on the correct point on the ground over which to leave the aircraft in order to land in the target area. There is more to spotting than just looking down since a good spot depends upon the direction and speed of the wind as well as several other factors.

Now that everyone is using high-performance canopies, spotting has become a lost art. Exit point selection is often so bad that even ram-air canopies are unable to bring the team back to the drop zone. Knowing how to spot will make you a lot more popular while it adds to your skydiving education.

> *The more advanced a canopy is, the more gentle you must be when controlling it.* - Charles Shea-Simonds

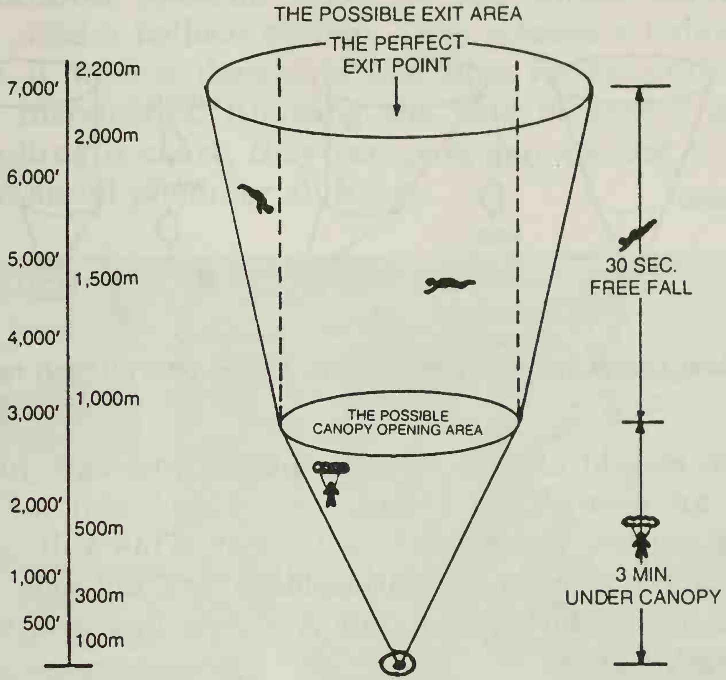




There is more to spotting than simply looking straight down

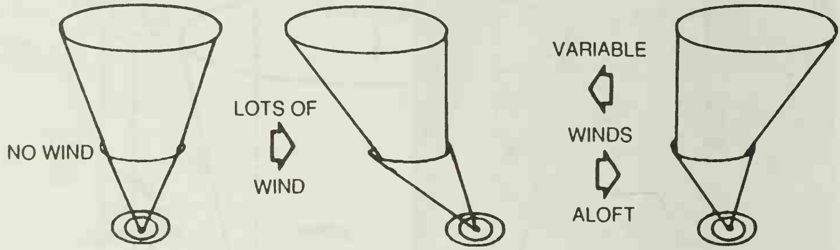
To begin with, let's think of the total descent as being in three separate phases: the *throw forward*, the *freefall drift* and *the canopy ride*. As you exit, you are traveling the same speed as the jump plane and are thrown forward in the direction of flight. Your trajectory is dependent mostly upon the speed of the aircraft at time of exit. The freefall drift is that distance you are moved by the upper winds (those between the aircraft altitude and the canopy deployment) and the third segment consists of the slower two to four minutes you spend descending under your canopy to the target area.

So, we must locate and consider four important points: the landing point (target), opening point (by compensating for ground winds), exit point (by compensating for the winds aloft and *forward throw*), and the engine cut point (to allow the plane to slow down and to compensate for the *exit lag*—the time you need to climb out).



The cone of maneuverability. Both tracking and canopy speed will make up for bad spotting to some extent.

Because both you and your canopy have a horizontal movement capability, you can make up for an imperfect spot to some degree, as well as compensate for changing conditions. The ever decreasing margin is called the *cone of maneuverability* and you must stay inside it. If you stray just one meter outside, there is no way you can get any closer to the disc than one meter unless the wind changes. As you descend, the maneuvering area becomes smaller and the situation more critical. Stay inside and you always have a chance at the disc. Most of your jumps will be made in lower wind conditions. When your canopy is able to penetrate the wind, there is no cone of maneuverability to worry about. If you go down wind of the target, you can still get back.



Now, crank in some wind and the cones take on their real shapes

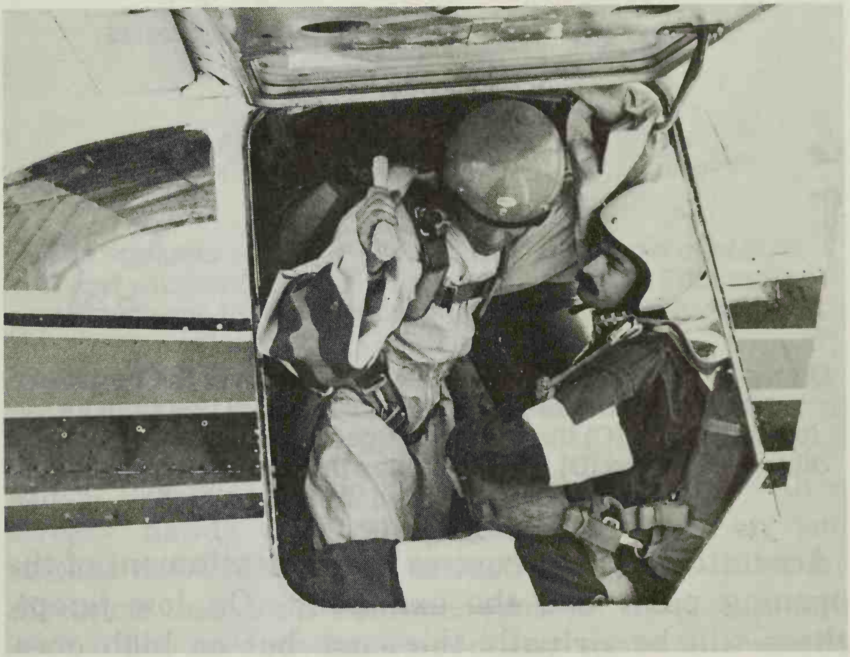
You should always spot as though you were jumping an unmodified round canopy and aim for the very center, the perfect exit point. This will allow you maximum compensation for errors and may be a blessing to the guy on your load who has to use his round reserve.

There are three practical ways to measure the wind for determining the opening point: observation, balloon system and wind drift indicator. Observation is the one most often used and it works satisfactorily with ram-air canopies on large open drop zones. The balloon system is rarely seen today. The wind drift system is very accurate but it uses expensive aircraft time.

—**Observation** is an easy way to determine changes in the spot. Watch the opening point of the group before yours and even ask their spotter where the jump run and exit point are. Obviously, observation won't work on the first lift of the day.

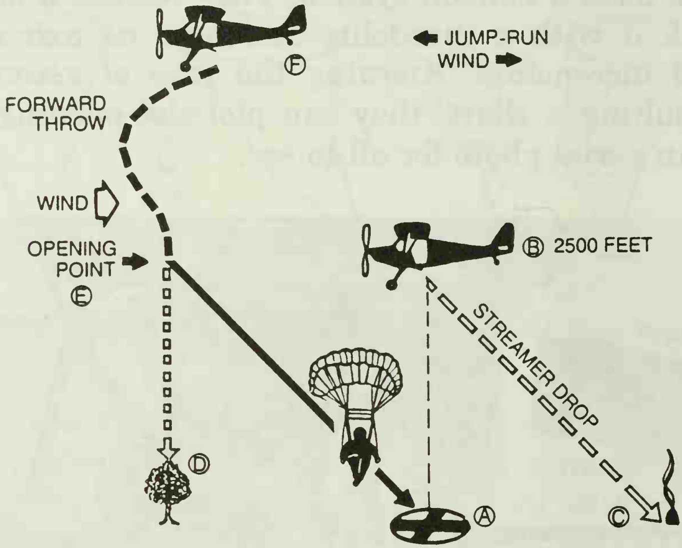
> *Some people spot 'em as they see 'em, some people spot 'em as they are, but there is no spot until you step out the door; and by then it really doesn't matter anyway.* - Lynn Levengood

—**Balloon system.** Some of the larger centers have used a balloon system. They release a balloon, track it with a theodolite and note its azimuth in time increments. Knowing the rate of ascent and consulting a chart, they can plot the opening point on an aerial photo for all to see.



Throwing the wind drift indicator

—**Wind drift indicator.** Another way to determine wind speed and direction is by dropping a wind drift indicator or *streamer* over the target at opening altitude. The WDI is normally a weighted piece of crepe paper designed to descend at the same rate as an open canopy. The wind will differ in intensity and direction at different levels and the specifics are nice to know when shooting an accuracy jump. Otherwise, it is sufficient to pick a point from the streamer drop and accept the mean effect of the wind.

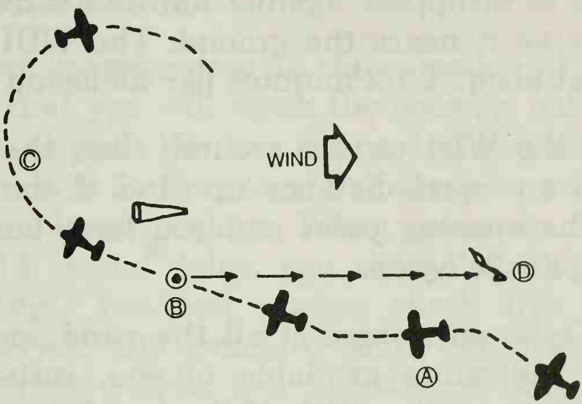


On the first pass, drop wind drift indicator over the target (A) at opening altitude (B). Draw an Imaginary line from its landing point, (C) through the target (A) to a point an equal distance upwind (D). This becomes the ground reference for the opening point (E) and the exit point (F).

Accurate spotting requires the ascertainment of the opening point and the exit point. On low jumps, these will be virtually the same but on high ones, there are many additional factors to consider.

Before takeoff, the pilot will select an approximate wind line based on the wind sock or wind Tee. Ordinarily, he will fly the streamer drop by approaching the target directly into the wind to minimize ground speed and give you as much time as possible. This approach will also minimize *side drift*; drift is when the aircraft is not both moving and pointing in the same direction.

> *Good judgement comes from experience, and experience?—well, that comes from poor judgement.*



The streamer run, A. Direct aircraft over target center, B. Throw wind drift indicator directly over target. Pilot makes shallow turns to the right keeping streamer in view through jump door, C. Streamer lands, D.

Make sure you have at least two WDIs aboard; keep one in reserve. Unroll the streamer a short distance, bunch it up and don't grip it tightly with a sweaty hand; you want it to unwind when you release it. Give course corrections to the pilot by direction and then amount, such as *right-five*, and wait a few seconds before spotting again so that the plane can level back out. If you are off-course, remember: The closer to the exit you are, the greater the correction you will need. If the pilot is on the radio or otherwise occupied, use hand signals. Throw the streamer down and back forcefully so as to miss both the step and the tail.

Make sure the wind drift indicator has unrolled properly and keep your eyes on it. If the pilot is not skilled at flying jumpers, suggest that *he* keep an eye on it. This way he will make climbing circles without blocking the view of the WDI with the

lowered wing. If you take your eyes off the streamer, it is sure to disappear against nature's camouflage, especially as it nears the ground. The WDI should descend at about 1 1/2 minutes per thousand feet.

Eyeball the WDI on the ground, then the target, and then an equal distance up-wind of the target. This is the opening point and you have built your *airborne parallelogram*.

Always take advantage of all the wind speed and direction indicators available to you, rather than relying solely on the WDI. If the last lift made the target, how did their spot compare with the direction indicated by the wind sock? When the smoke leaves that chimney, does it change course after rising a bit? At what angle does it leave the stack? Which way are those small puffy clouds moving? When you are in the air, check the shadows from the clouds on the ground. Is anyone down there kicking up dust? Look for farm machinery, cars on dirt roads, etc.

The opening point will be up-wind from the target about 1/4 mile for each five mph. of ground wind velocity. In fact, the true opening point may be even farther since the wind usually blows faster as you go higher, due to the friction provided by the ground. The distance to the correct opening point adds up fast.

There are other complications too. Heat waves create a mirage and make the target appear to be farther down-wind than it really is. Mirages contribute only about 15 feet for each knot of ground wind, but this will make a difference if there is a *dog leg* in

the wind, i.e., the ground and upper winds are up to 90 degrees different.

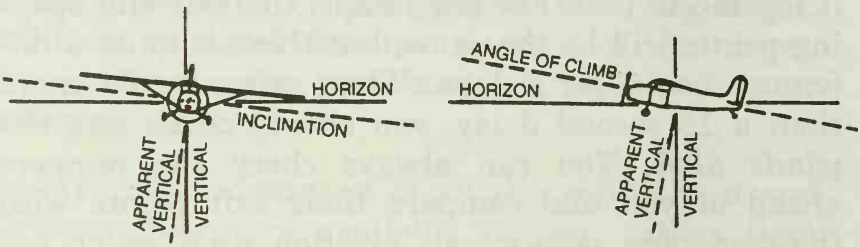
The next consideration is the selection of the *exit point* so that you will reach the *opening point* when it is time to pull. For low jumps, the exit and opening points will be the same, but there is quite a difference on longer delays. When going up for more than a 15 second delay, you should check into the *winds aloft*. You can always check the jumpers ahead of you and compare their exit points with their opening points, call aviation weather or ask the pilot, prior to exit, if he senses any changes in the winds aloft. Above 9,500 feet, compensate 1/4 mile for each 15 mph. of wind. Below 9,500 feet, cut the correction in half. The effect of the winds aloft on your fall will depend on how much time you are in freefall. Falling slowly, spread and stable, you will drift farther than in a full delta position.

The selection of the exit point will also be affected by the amount of *forward throw*. As you exit, you are traveling the same speed as the jump ship and are thrown forward. Your trajectory is dependent mostly upon the speed of the aircraft at the time you leave the step, and it is considerable.

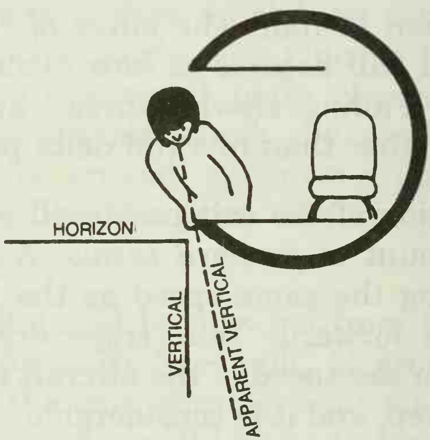
Exit lag (the time it takes to climb out the door) must also be cranked into the computations. If you are making a door exit by yourself, there is no lag and you can forget this part, but a poised exit may take you 1/8th mile. For a group of three to four strut hangers, allow 1/4 mile or more.

On large relative work loads, don't compensate for exit lag, spot the base over the exit point. Everyone else on the load will be flying back to the base.

Forward throw and exit lag may be cranked in together because they are in the same direction. For jumps over 9,500 feet, shorten the *cut point* 200 yards. For lower jumps, use 100 yards.



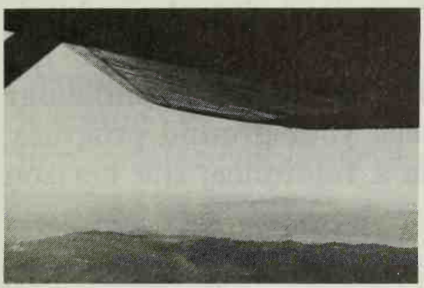
Make sure the plane is flying level



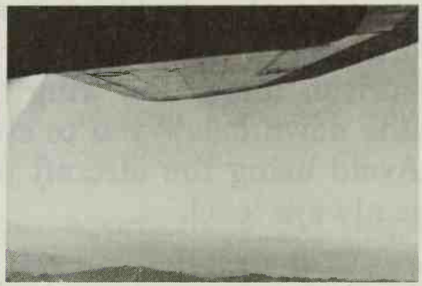
Don't use the side of the plane as a reference point

Now that you can calculate the cut point, the next task is to direct the jump ship over it. First you must learn to look straight down. This is especially important just before you call for the *cut*, requesting the pilot to throttle back the engine to slow the airplane, because there is no more time to call for course corrections. And where is *straight down* anyway?

Check the attitude of the plane. If the nose is high as you approach the exit point, you may be looking too far forward and may exit too soon. If your pilot is flying with one wing low, you may be looking down at an angle and be way off the wind line. If you cock your head forward during spotting, you may exit too soon.



Aircraft climbing



Aircraft descending

Right wing low

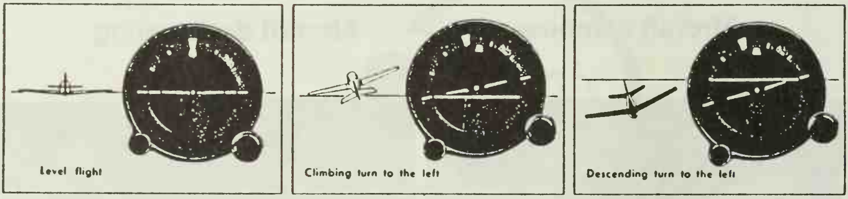
Correct

Check the attitude of the plane by comparing the wing tip with the horizon

Glance at the artificial horizon and the needle-ball indicator in the instrument panel. If they aren't centered, bring them to the pilot's attention and ask him to *level the wings*.

Don't use the side of the aircraft as a reference point. If it is curved, you probably won't be looking

straight down. Keep the corrections small, in five degree increments. Big corrections almost always require a banking turn and it takes a while to get the plane back to level. The pilot will try to make uncoordinated, flat (skidding) turns to help keep you oriented. If he made normal coordinated banked turns, you would have difficulty determining which way is straight down. Stick your head out, look straight ahead at the horizon and then look down, drawing a perpendicular line. Then look at the horizon under the wing and draw a perpendicular line down below you to check your ground progress. Avoid using the aircraft as a reference; the horizon is always level.



Check the artificial horizon to see if the plane is level

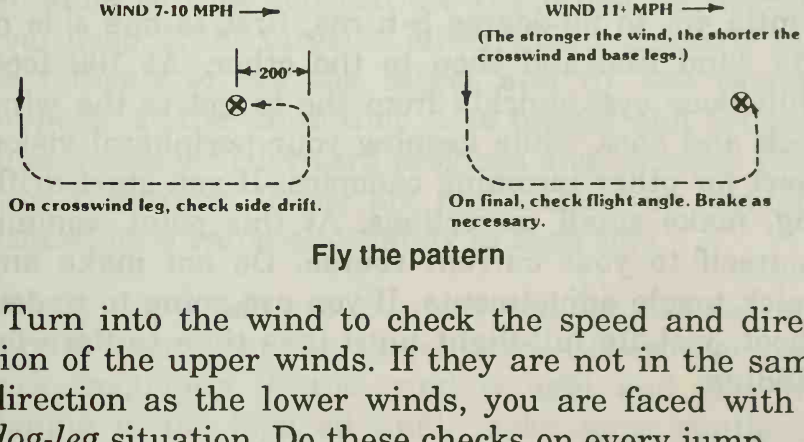
Most spotting errors place the jumpers in the air short and too far left. To be safe, go long. Everyone would rather run a little than have to hold, bucking winds and wondering if they are going to be blown past the DZ.

Once you have passed the cut point, call *cut!* to the pilot, wait a few seconds for the plane to slow, then climb out; your spotting is finished. You don't have time for any more course corrections. You can't spot properly from outside the door after the cut, with the airplane going nose-low and people hanging everywhere. Besides, no correction can make much difference at this point.

If you find yourself under the canopy much too far upwind, you will have to run for the target immediately and with maximum efficiency. Pull your toggles to one-quarter brakes to minimize your sink rate. Next, decrease your parasitic drag by making your body as small as possible. Draw your knees up to your chest. This will be easier if you slide your leg straps toward your knees. Hold your hands in front of you and suck your head down.

Spotting sounds difficult but it really isn't. Start learning to spot as early as you can, so your jumpmaster can observe and correct you.

Flying the pattern. Your approach to the target is quite similar to an airplane's approach to a runway. You will fly a *left-hand pattern* unless local rules are otherwise. Everyone must fly the same pattern to keep the air traffic orderly. Within the pattern, you will fly four *legs*: a *crosswind leg,* a *downwind leg,* a *base leg* and a *final approach.* Check your position and altitude on each leg. Fly the pattern the same way on every jump, continually adjusting and refining it.



Fly the pattern

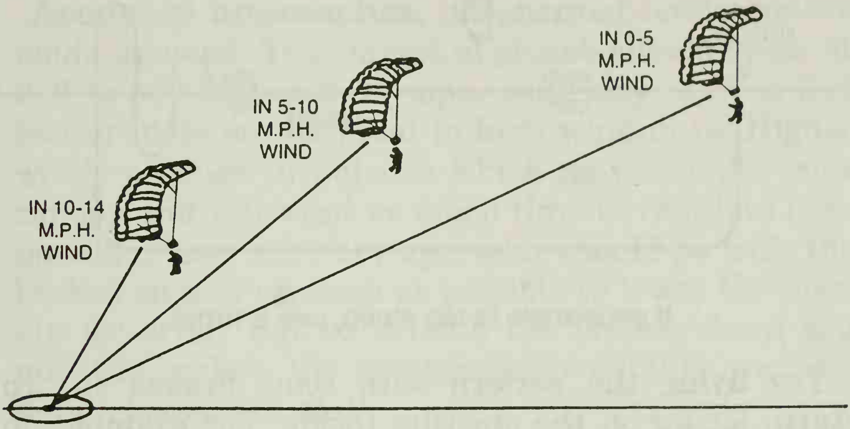
Turn into the wind to check the speed and direction of the upper winds. If they are not in the same direction as the lower winds, you are faced with a *dog-leg* situation. Do these checks on every jump.

Enter the *crosswind leg* on the windline, 600 feet directly upwind of the target at 1,000 feet AGL.

Turn on the *downwind leg* at 800 feet with your toggles up. Fly parallel to the wind line, passing above the target area about 400 feet to the side of the target at an altitude of about 600 feet. Flying down wind, you should be moving rapidly across the ground. Keep an eye on the target and the wind sock. If you are going too fast on the downwind leg, cut it short and turn on base leg sooner.

Turn on the *base leg* at 400 feet past the target. You should have an altitude of 500 feet. Check your angle to the target. If winds are high and your angle is too shallow, cut across to intercept *final*, closer to the disc. If your angle is too steep, fly the base leg past the wind line and then make a 180-degree turn to fly back. Check your angle again and repeat to the opposite side, if necessary.

Turn on *final* at 400 feet or higher. Keep the toggles up and adjust your angle to the landing area with S-turns. If it appears you may overshoot the target (it seems to be moving under your feet), make gentle 45- to 90-degree S-turns, first to one side of the wind line and then to the other. At 100 feet, shift your eyes quickly from the target to the wind sock and back while keeping your peripheral vision alert for other incoming canopies. If you start drifting, make small corrections. At this point, commit yourself to your current course. Do not make any quick toggle adjustments. If you are going to undershoot, just fly full-flight until it is time to flare for landing.

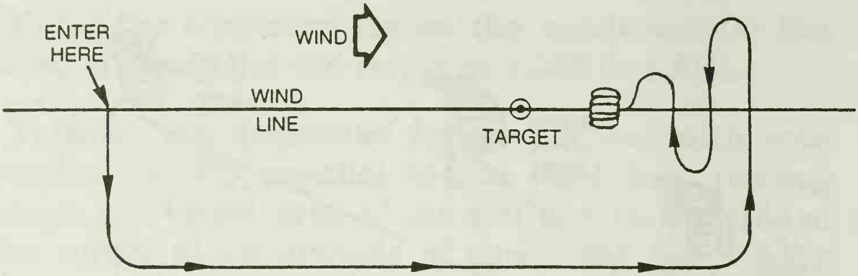


Glideslopes you can expect for given winds

When the winds are high—over 15 mph.—you may enter the pattern at a lower altitude, you will stay farther upwind on the crosswind leg, and you will fly tighter to the target on the other legs. The higher the winds, the steeper your final approach will be. If you go behind the target, you may not be able to get back.

If the winds are faster than the forward speed of your canopy, you may have to *back in* to the target. Position yourself just to the right or left of the windline so that you can see the target by turning your head. If the target is directly behind you, it will be difficult to see the target and fly the canopy properly at the same time. Use brakes and S-turns to decrease your forward progress and increase your rate of descent. If you are not backing up enough, *fishtail* by turning alternately to each side.

When the winds are low, you will be able to venture farther from the target area. Check the wind sock frequently. If the wind is light and you are coming in too high on final, make some gentle S-turns to lose some altitude.



If your angle is too steep, use S-turns

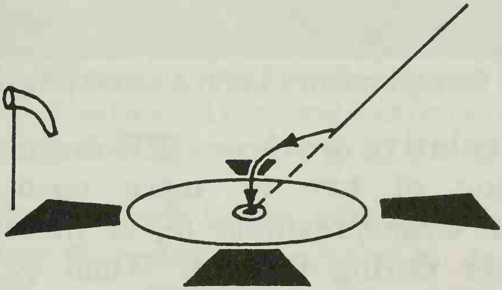
Try flying the pattern with some brakes on. To turn, let *up* on the opposite toggle. For example, to turn right, let up on the left toggle. Steering this way from half brakes will give you a more stable turn. Remember that sudden or radical turns will increase both your horizontal (swing-out) and vertical speed, which is very dangerous near the ground.

Your landing approach will depend upon your canopy. Nine-cell ram-airs react differently from five-cell squares. Consult your instructor and the canopy manufacturer.

Landing on the disc in accuracy competition

Accuracy approaches, like normal landings, are made up-wind. Your target approach should begin at 200 to 500 feet on 1-10 mph. wind days and at 500 feet or more on marginal to high wind days. Higher winds produce turbulence which may collapse your canopy and you want as much time to reinflate it as possible. Your accuracy approach should be with the brakes on and as steep as possible to lower the margin for error. But be careful; the farther down you pull the brakes, the greater the possibility you will not just *sink*, but *stall.*

If you have the toggles pulled down so you are near the stall and then you see you are going to overshoot the target, forget the target. Keep the canopy flying straight ahead and land safely. If you bury the toggles at this point, you will probably drop out of the sky. If you try a *hook* or fast low turn, the canopy will bank, you will swing rapidly to the side and you will probably be injured.

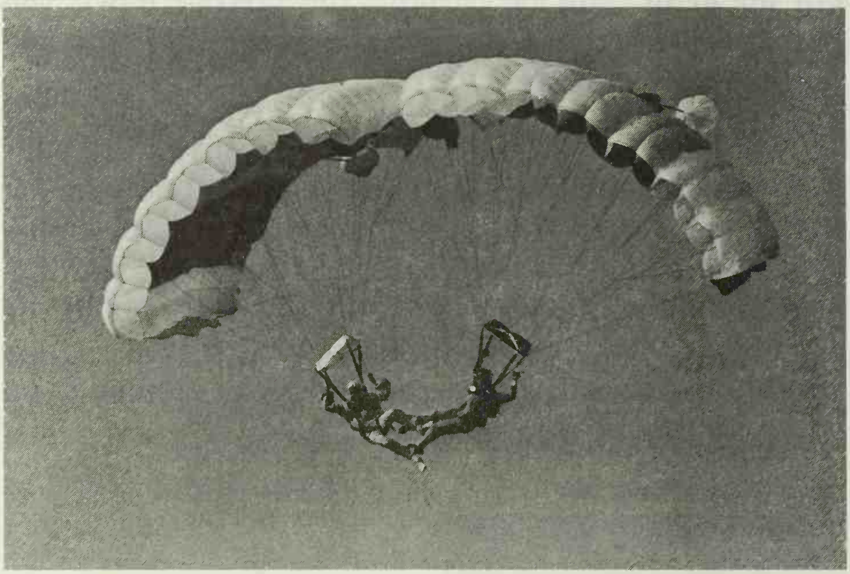


Sink down to the target

Keep toggle movements to a minimum and do not shift around in the harness. Let your legs hang below you relaxed until the last second or two. Then depress the toggles past the stall point to sink the

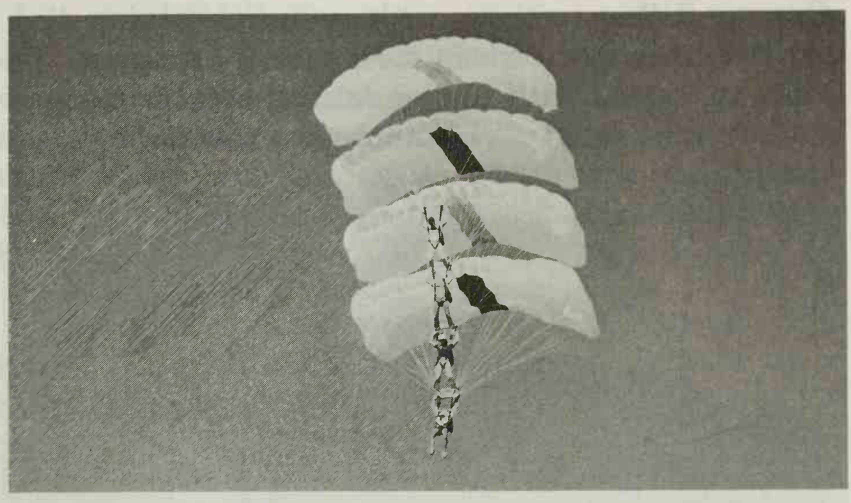
canopy down to the disc in a near vertical descent. Do not jab your foot at the disc; just place it there. If the disc is in front of you, place your heel on it. If it is below you, use a heel or toe; and if the disc is behind you, use your toe.

In warm air, your canopy will sink more quickly and it may not react immediately to toggle changes.



Canopy relative work: A side-by-side

Canopy relative work or *CRW* is the intentional maneuvering of two or more open parachute canopies in close proximity to, or in contact with, one another during descent. When two or more canopies hook-up one above the other in flight, the formation is called a *stack* or a *plane*. Good CRW is smooth formation flying. Bad CRW results in collisions, deflated canopies, entanglements, injuries and even death. While ram-air canopies move fairly slowly, they owe their rigid shape to inflation. They lose their shape and flying ability when stopped or when the lines lose their tension.

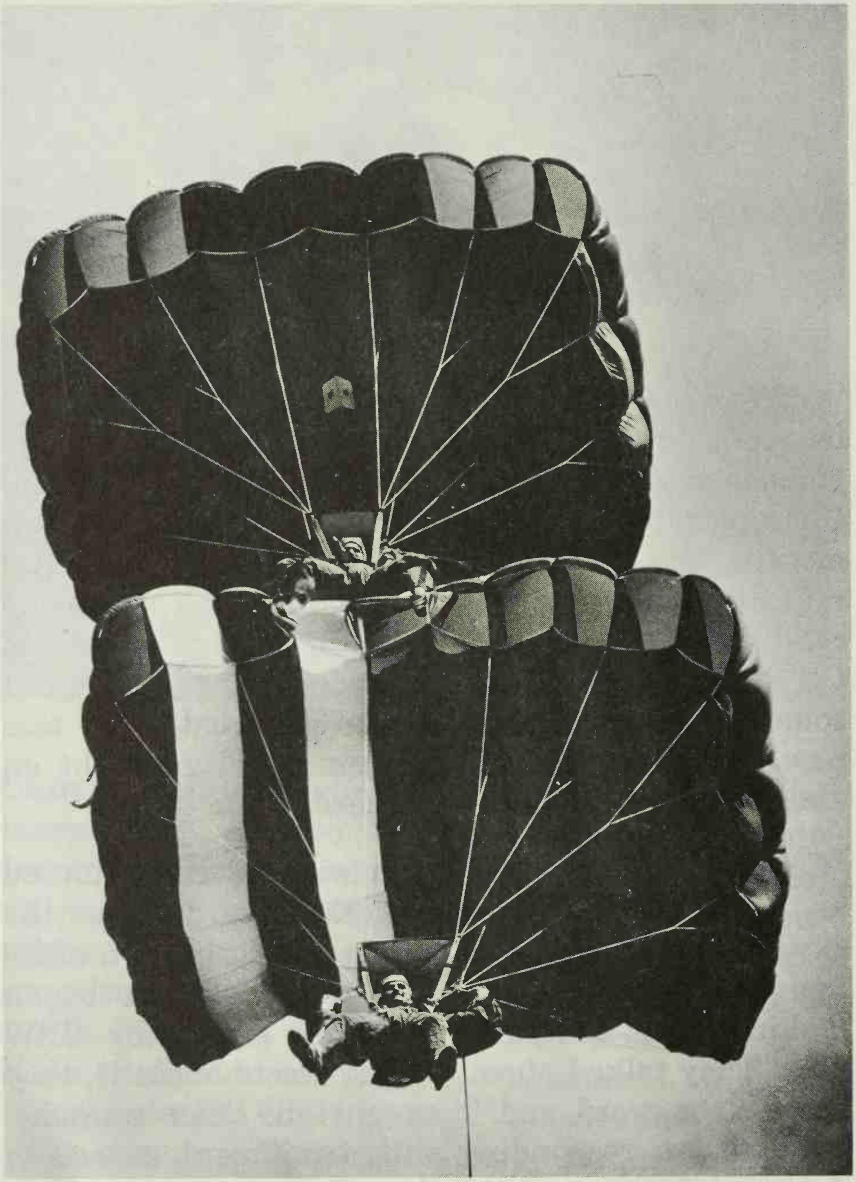


A four plane

CRW, like so many other activities in parachuting, began as a stunt. First practiced in 1976, it was demonstrated to the world at the U.S. National Championships in Tahlequah, Oklahoma. A few months later this author penned a parody article reflecting the growth and growing pains of canopy relative work, and illustrated it with a couple of CRW photos he had taken. Some liked the joke, but some took it seriously and many decided to try this new form of aviation. The new activity caught on and soon demanded its own place in the sport.

Canopy relative work began with, and was touted as, something for relative workers to do after the skydiving was over. But it soon carved its own niche and developed its own following. Jumpers began making clear-and-pulls from ten grand for CRW only. They talked about it, they wrote about it, they spread the word and it caught on. Soon manufacturers were responding with equipment especially designed for canopy relative work. And soon CRW became a world-class competitive event.

Canopy RW is accuracy with an aerial moving disc, and it is relative work in slow motion; many of the basics of freefall RW apply. And, the excitement of being in the formation lasts minutes, not seconds.



A stack: the upper flier is sitting on the leading edge of the lower canopy

Like freefall relative work, CRW requires training and practice. The novice should learn one-on-one with a seasoned practitioner. You will start practicing planes rather than stacks, as planes are much more stable. See the USPA *Skydiver's Information Manual* and the books listed in the Appendix of this book.

The two most experienced fliers usually hook-up to form a CRW *base-pin*. Then the rest dock in their assigned slots. Never fly in front of a formation or your wake will disturb the formation's stability. Dock from behind and below with a moderate approach angle. If you are docking third or later, aim for the center section and hook your legs behind and around the lines of the center cell. If the canopy you dock with collapses, release it immediately. If the flier yells *DROP!*, he or she wants you to let go immediately. Keep conversation to a minimum and verbal commands concise and direct. Minimize control movements to minimize oscillations: It is easier to dock with a stable canopy. Approaches and docking should stop by 2,500 feet. Only very experienced CRW pilots should attempt to land a formation, and then not in high or gusty winds.

To take part in CRW, you must have logged at least 20 jumps on ram-air canopies, have a thorough knowledge of ram-air canopy flight characteristics to include riser maneuvers, and be able to land within five meters of the target consistently. And you will need some special equipment: a hook knife for canopy entanglements, ankle-high socks to protect from line burns, a short or retractable bridle on your main canopy so it will not catch on another flier's gear, and cross-connector straps between front and

rear risers for building planes. You should also carry an altimeter, wear a helmet with ear holes to allow hearing, soft toggles to avoid entanglements, trim tabs for equalizing descent rates, at least two rows of crossports in your canopy to aid canopy reinflation, and non-cascaded A (front center) lines. Lanyards or straps for hand planes should not be used.

The best times of the day to make CRW jumps are early and late. Winds are normally lower and less turbulent, so you are less likely to encounter thermals and other bump causers. Turbulence makes CRW difficult, if not impossible, and it certainly increases the danger.

Whenever you plan to deploy your canopy more than 3,500 feet above the drop zone, inform the pilot of the jumpship and everyone on board. If there are two or more aircraft in the air, make sure your pilot radios the message to the other pilots.

Chapter Seven

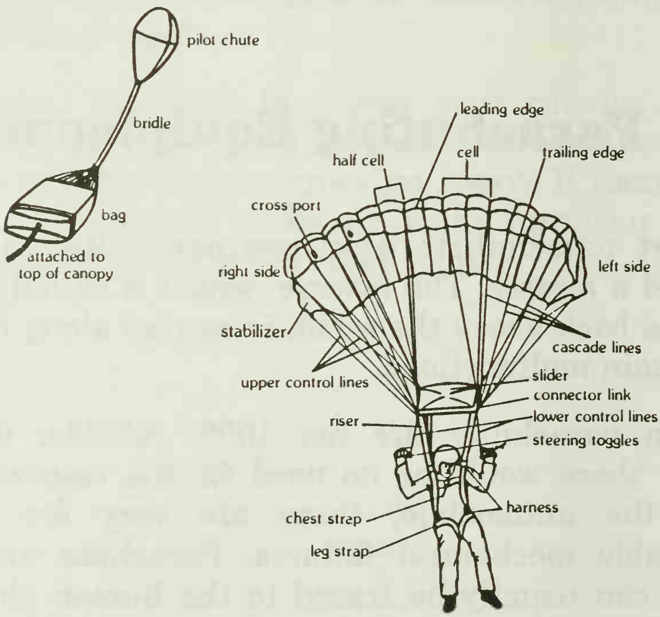
Parachuting Equipment

Sport parachutists wear two parachutes, a *main* and a *reserve*. The reserve, which is usually worn on the back above the main, is carried along in case the main malfunctions.

Main parachutes are not 100% reliable; if they were, there would be no need for the reserve. But, like the automobile, there are very few unexplainable mechanical failures. Parachute malfunctions can usually be traced to the human element, specifically: packing, body position at pull time, or poor pre-jump inspection. Consequently, while you will be packing your own main parachute, your reserve will be inspected and repacked every 120 days by a government licensed parachute rigger. Your instructor or jumpmaster will carefully supervise your static line and freefall progression. They will train you, test you, and you will undergo a rigid

equipment check prior to boarding the jumpship. The key to success and enjoyment in sport parachuting is knowledge; you will want to learn as much as possible about the equipment right from the very beginning.

The parts of a parachute. The parachute assembly is a train of interrelated parts which are carefully engineered into a chain. To keep the weight and volume to a minimum, each part is made just strong enough (plus a safety factor) to handle its share of the opening forces.



The components of the sport main parachute

> The ram-air canopy is a true flying machine. Before using one, you must complete a controlled program of instruction, and should read and understand all appropriate flight manuals and packing instructions. If you do not have the manuals, send to the manufacturers for them.

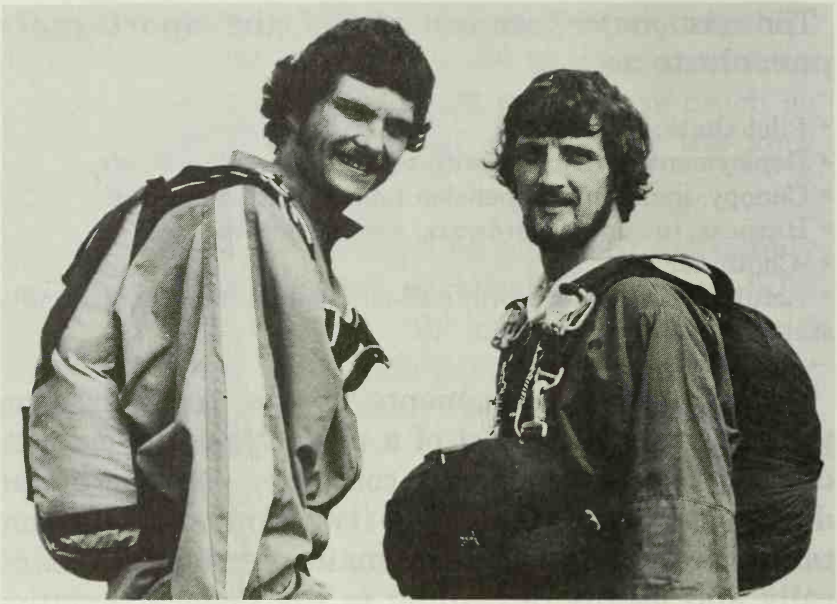
The six *major* components of the **sport** ***main*** **parachute** are:

- Pilot chute, with bridle.
- Deployment device: bag with retainer line, diaper, etc.
- Canopy, including suspension lines, slider and risers.
- Harness, including hardware, ripcord pockets, etc.
- Container.
- Actuation device: ripcord, pull-out handle, throw-out handle, static line, etc.

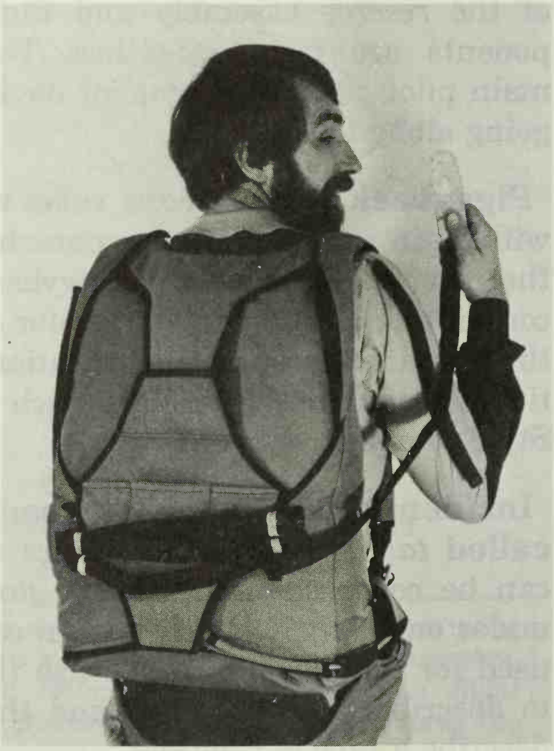
The six *major* components of the **sport** ***reserve*** **parachute** also consist of a pilot chute, deployment device, canopy, harness, container and actuation device, but the harness and (two compartment) container are shared with the main parachute. Technically and legally (according to the Federal Aviation Administration) the harness and container are part of the *reserve* assembly and the six reserve components are tested together. The non-certificated main pilot chute, deployment device and canopy are going along for the ride.

Piggyback verses front reserve mounting. You will begin jumping with a parachute system where the reserve container sits piggyback above the main container. Most jumpers prefer the *hogback* but there are some special applications for the conventional front mount reserve, such as the Individual Style competitive event.

Incidentally, piggyback packs used to be called *tandem containers*. Since *tandem containers* can be confused with *tandem jumps* (two jumpers under one canopy), and tandem containers are even used for tandem jumps, we use the term *piggyback* to describe the equipment and the word *tandem* to describe a type of jumping.



Piggyback containers and front mount assembly



The Telesis piggyback fitted with a static line

Static-line parachute assemblies for students are fitted with static lines and Practice RipCord Pull (PRCP) handles.

Tandem jumping equipment consists of an oversize main canopy (390 to 425 sq. ft.) engineered to carry two people, and individual harnesses designed to snap together. Because the passenger and instructor are snapped together in tandem (passenger in front and instructor in back), their weight is doubled while their wind resistance is not. Consequently, their potential terminal velocity is greatly increased. A four-to-five foot diameter drogue chute is deployed soon after exit to trail about 12' above and behind, slowing them to around 120 mph. from the 200 mph. they would be traveling without a drogue. The drogue has other advantages too: It acts as a stabilizer for the two skydiving bodies while ensuring positive canopy deployment by pulling out the main.

Tandem equipment was pioneered by Ted Strong of Strong Enterprises in Orlando, Florida, and Bill Booth of the Relative Workshop in DeLand, Florida. (Addresses are in the Appendix.) These two companies manufacture slightly different variations of equipment based on the same basic principle.

Equipment regulations. The design, maintenance and alteration of parachute equipment is regulated by the Federal Aviation Administration of the U.S. Department of Transportation, which publishes the *Federal Aviation Regulations* (FARs). The following FARs apply to parachuting in whole or in part:

Part 65 - *Certification of Parachute Riggers*
Part 91 - *General Flight Rules*
Part 105 - *Parachute Jumping*
Part 149 - *Certification of Parachute Lofts*

In addition, the FAA publishes *Advisory Circulars* from time to time to explain the regulations. For example, AC-105-2 explains in detail various areas of parachute equipment maintenance and modification.

TSO. *Reserve* parachutes must be *approved* prior to use under the government's *Technical Standard Order* (TSO) system either as modified military surplus or through rigid tests on newly designed and manufactured civilian equipment. Reserve parachute assemblies must be (1) tested and certificated and must be (2) manufactured under an approved quality control system.

The *main* parachute assembly—canopy, container, risers, etc.—does not have to be *approved* but any further *alterations or repairs* may only be made by qualified, licensed parachute riggers.

TSO C-23c dictates that all *certificated* parachutes (reserves and those used by pilots) must meet the performance standards set forth in AS-8015A published by the Society of Automotive Engineers. FAR Part 21 outlines the procedures for certifying a parachute or a component part. For complete details on the regulations, testing and the TSO system, see *The Parachute Manual* by Dan Poynter.

> *Parachutes should not be rented or loaned to persons unqualified to carry out an intended skydive or to persons of unknown ability.* - USPA's Skydiver's Information Manual

Repairs. *Minor repairs* (those which, if done incorrectly, would not materially affect the airworthiness of the parachute) may be performed by a licensed *senior* parachute rigger while *major repairs* and *alterations* may only be performed by *master parachute riggers* and licensed parachute lofts (lofts must have at least one master parachute rigger on the staff).

Jump pilots and *observers* (those going up for the ride—not jumping) are also required to wear parachutes in the aircraft, but they usually use regular, round, unmodified, emergency gear, not sport models. And they only wear one parachute. The pilot is using the plane as his primary source of transportation, and he wears a parachute in case it might fail. The sport parachutist uses the plane as an *elevator*, a main parachute as his primary source of transportation and a reserve for use if the main fails. Hence the difference.

The deployment of the sport main parachute takes about three seconds and is divided into three separate functions: Activation, deployment and inflation.

1. Activation: The container is released from its locked position by pulling a ripcord, hand-releasing a pilot chute or withdrawing the static line, depending on the system design and use.

2. Deployment: The pilot chute *anchors* itself in the air and lifts the bag with the packed canopy out of the container. As the jumper falls away, the lines pay out from their rubber band stows until *line stretch*. (The last stow or stows lock the canopy into the deployment device.) When the last stow

withdraws, the *trap door* closing flap opens and the canopy is pulled out of the bag.

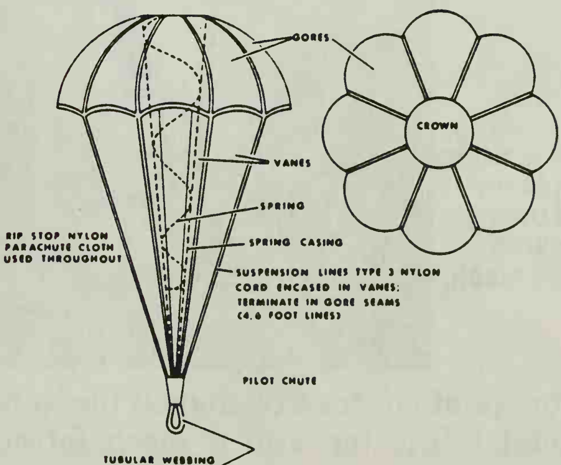
The bagged main canopy lifts off

The slider slows spanwise expansion of the canopy

3. Inflation: The ram-air canopy inflates from the underside and tries to expand in a span-wise (side to side) direction. At the same time, the center cells get a bite of air and inflate. The expansion of the canopy is retarded by a slider until the jumper has slowed. Then the slider slides down the lines, allowing the canopy to fully inflate. The opening sequence is in the reverse order in which the canopy was packed.

The *ram-air* **sport reserve** operates in the same manner. *Round* reserves are activated and deployed in a similar manner but the inflation process is different.

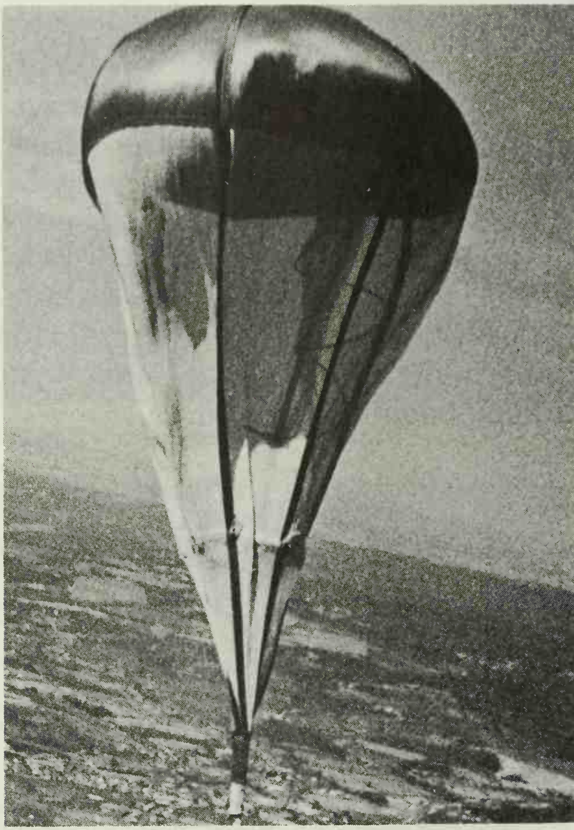
The pilot chute is a small round canopy which enters the air stream to anchor itself there and withdraw the main or reserve canopy from its container, then keeps the lines extended until the canopy begins to spread.



The A-3 spiral spring, vane type pilot chute

We are the first generation to have the possibility to fly with our own wings. - Magnus Mikaelson

The first personnel parachutes were used while flying in balloons and, since they were static line operated, a pilot chute wasn't necessary. With the perfection of the manually-operated parachute in 1919 came a collapsible, spring-loaded pilot chute. The hemispherical, conical or flat octagon, spiral spring *vane type* pilot chute has been used for years and has proven to be an excellent design.



Some pilot chutes are completely enclosed on the bottom with marquisette mesh

Most sport pilot chutes are shaped like a beach ball with a solid fabric top and a mesh fabric bottom. This simple design will not catch on the feet. Main parachute pilot chutes are usually limp and must be pulled from their stowage pocket by hand, while reserve pilot chutes have a spiral spring to launch

them from the pack. Removal of the spring reduces both weight and volume. Without the coiled spring, main containers are simpler to build and easier to close.

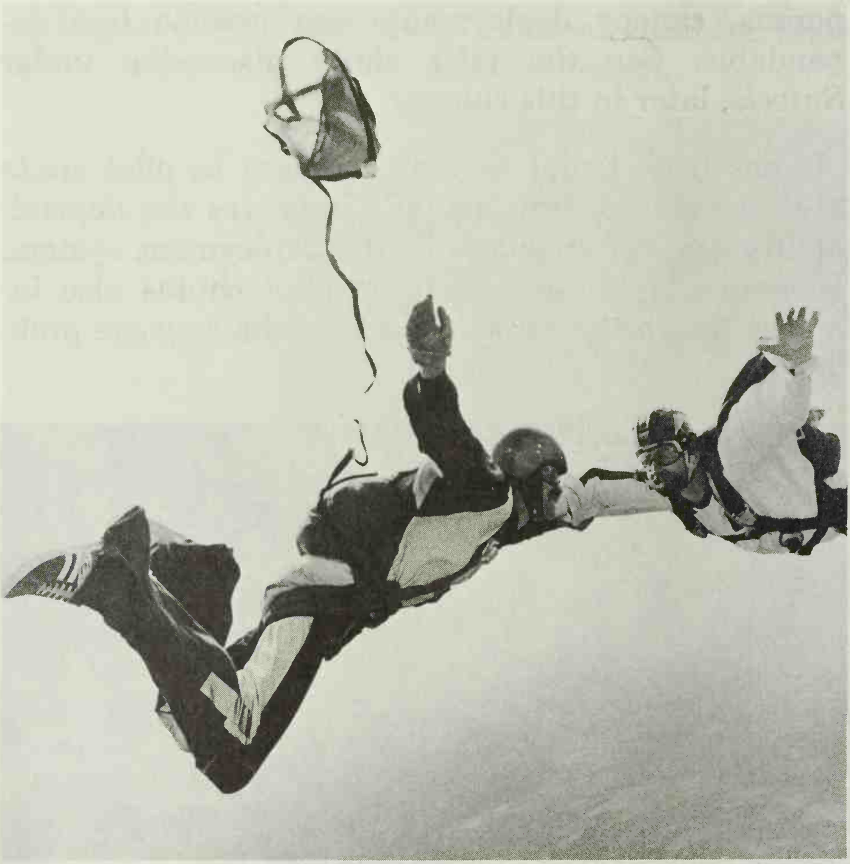
Pilot chutes wear out. As their fabric becomes more porous, canopy deployments can become less dependable. See the pilot chute discussion under *Snivels*, later in this chapter.

It has been found that an increase in pilot chute area (increased drag) usually improves the dependability and effectiveness of the deployment system. However, larger and multiple pilot chutes also increase the *snatch force* and add to the stowage problem.

The ripcord releases the spiral spring pilot chute

The *ripcord activation system* has a pin and loop arrangement to lock the container closed. When

the ripcord is withdrawn, each pin slides out of its loop and the spring-loaded pilot chute jumps from the container, withdrawing the canopy. This system is commonly used in student mains, sport reserves and pilots' emergency parachutes.



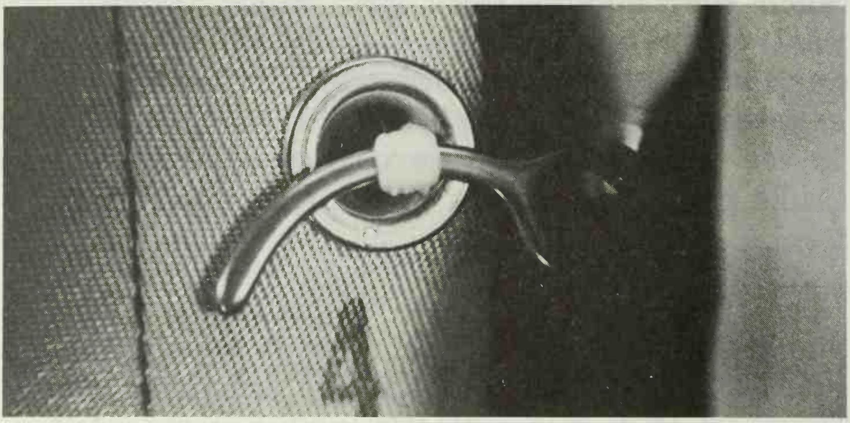
The throw-out pilot chute system

The *throw-out*, hand-deployed pilot chute is stowed in a pocket on the belly band or on the back of the right leg strap (but possibly on the bottom or the back of the main container). Early throw-outs were mounted on the belly band and this is still the easiest place to see and grasp, but it is not *idiot proof*. Some jumpers put a twist in their belly bands

when they donned their gear which trapped the pilot chute bridle. Adding stiffeners to the belly band solved that problem but made the belly band awkward. The leg strap location is not quite as easy to see but it reduces the chance of a mis-routed bridle and it allows for a pull in a comfortable direction.

The throw-out pilot chute doesn't have a spring; you simply pull it out of its stowage pouch by hand and let it go. The handle, usually consisting of a 2" length of 1" diameter plastic tubing, is mounted on the apex of the pilot chute and sticks out of the stowage pocket. The pilot chute does not inflate in the air stream until the jumper lets it go because it is upside down. When the jumper throws the pilot chute away laterally and vigorously, it rotates 180 degrees and inflates. The inflated pilot chute now acts like a skyhook to extend the long bridle, pulling the bridle-mounted curved pin which locks the container, and lifting out the bagged canopy.

Stow the pilot chute with the fragile mesh inside and the slippery fabric outside. Neatly fold excess bridle and place it inside the pilot chute. The whole bundle should slide easily into the pouch. The throw-out pouch should be sized to match the pilot chute and have an elastic opening, or be made of elastic fabric. Only the plastic handle should peek out of the pouch. The pilot chute will pull the curved pin more easily if you will leave a couple of inches of loose bridle near the pin. After you put the parachute on, run your fingertips along the bridle to make sure it runs straight from pouch to pin. Press any separated Velcro back together. You do not want to snag your bridle on a door frame.



The pilot chute pulls the curved pin locking the pack

You may test your throw-out system by placing the packed parachute on the ground. Extract the pilot chute from its stowage pouch and pull straight up. The bridle Velcro should unpeel. Then the main pin protector flap should open. There will probably be enough friction between the closing pin and the locking loop for the containers to start lifting off the ground. If you are able to lift the packed parachutes completely off the ground without clearing the pin, consult your rigger.

The pull-out pilot chute system

The ***pull out*** hand-deployed pilot chute has a pillow type handle or *pud* of foam-filled fabric mounted on the lower right-hand corner of the main container. The handle is connected directly to a straight metallic pin on an 8-10" line. This short line passes through a grommet which is mounted at the base of the pilot chute. As the handle is pulled, the pin clears the locking loop and releases the container. As the pull continues, the pilot chute is withdrawn from the container. The pilot chute inflates in the air stream next to the jumper because the handle is at the base of the pilot chute. Then the pilot chute/handle are released. The inflated pilot chute pulls from above to extend the bridle and lift the bagged canopy from the container.

Pilot chutes wear out. As their fabric becomes more porous, canopy deployments can become less dependable.

The principal advantage of the pull-out is that the shorter bridle keeps the pilot chute closer to the top of the inflated main canopy, where it is less likely to fall over the leading edge to entangle with lines when the canopy is braked.

The principal disadvantage of the pull-out is the location of the handle—behind the jumper where it is out of sight and is more difficult to locate and grab. If the handle is attached to your container with Velcro, have the hook and pile strips replaced regularly to avoid a floating handle.

Hand deploys, throw-out and pull-out, not only eliminate the main ripcord and housing, they permit a smaller main container. The pack achieves a thinner profile because it doesn't have a coiled spring

inside to make it thicker. Pulls must be vigorous and to full arm extension, to get the pilot chute out into *clean* air. About 90% of the experienced jumpers use the throw-out while 10% prefer the pull-out. The choices vary from region to region.

Whenever you change equipment and main parachute activation systems, you must train with it thoroughly. Start in a suspended harness and then make a solo jump which includes several practice pulls and an actual pull at a higher than normal altitude. The problem is that you must break an old habit (reaching for where the ripcord was) as well as learn a new one.

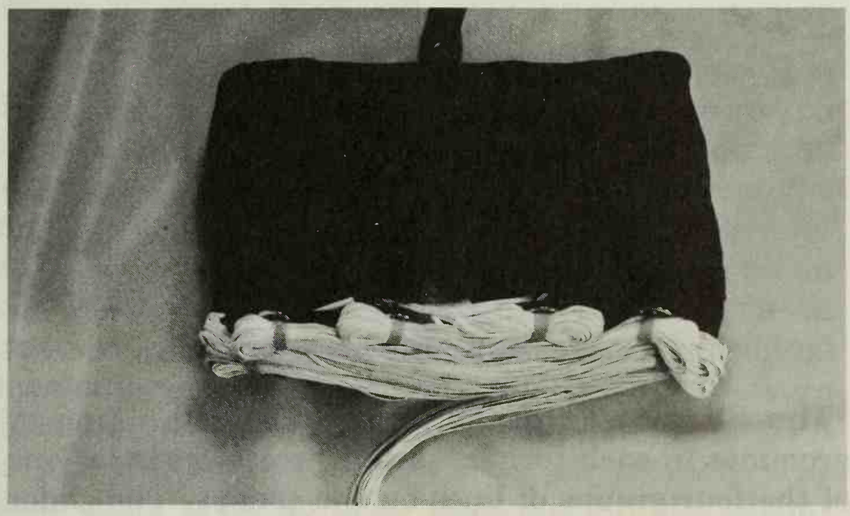
Pack closure loops. Nylon pack closure loops wear out. Yours will last longer if you will slide your pull-up cord out slowly and position it under the pin so that the cord does not rub on the closure loop. Rub a little paraffin or beeswax on the loop to extend its life and make pulls smoother. When replacing closure loops, check the owner's manual for correct material and length. Do not just duplicate the loop in the pack—it may have stretched. A piece of elastic webbing sewn over the washer will keep the loop from being lost when jumping. Or, you may even use a piece of adhesive tape.

The bridle, or *pilot chute connector* cord, is a piece of line or nylon tape which connects the pilot chute with the canopy or the deployment device. Bridles come in various lengths and strengths and may be either tied on, sewn on, or sewn and looped on.

Deployment devices, sleeves, bags, diapers, etc., offer several advantages over straight deployment: They are found on virtually all main and reserve

canopies. Deployment devices reduce the *snatch force* of the deploying canopy by reducing its inflated size at line stretch. A parachute with a deployment device will open more reliably because the lines pay out stow-by-stow, and then become more evenly loaded prior to canopy inflation. They tend to save the canopy from damage by making the deployment more orderly.

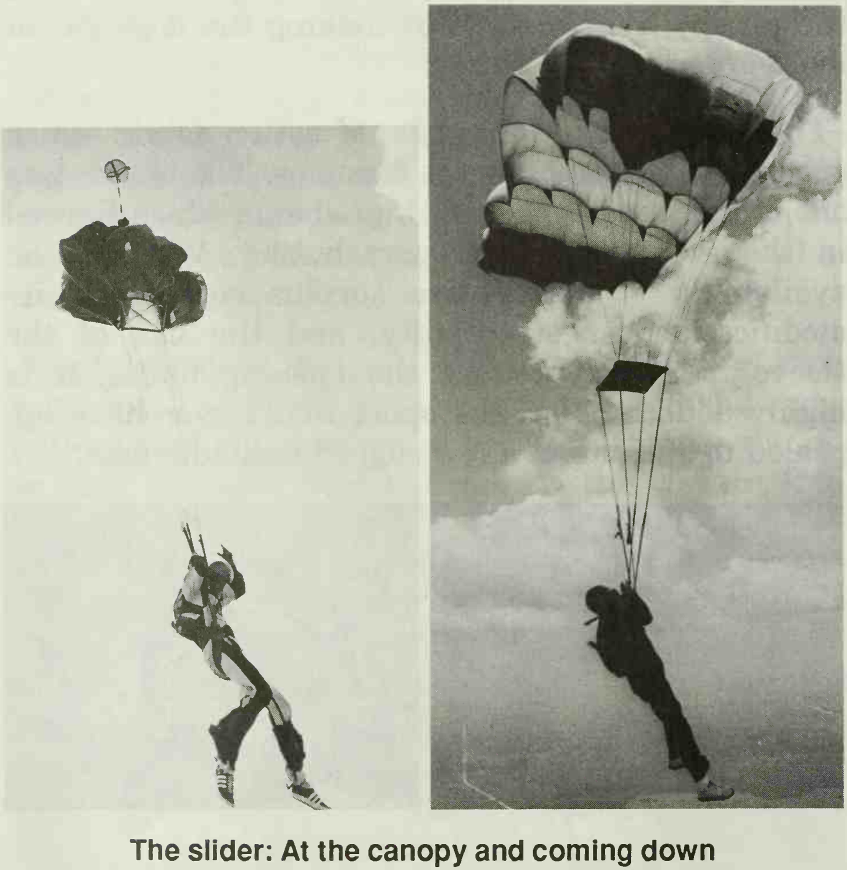
The sleeve is a long tube of cotton fabric which encases older, round sport canopies. The sleeve was one of the important basic ingredients which figured in the growth of sport parachuting. Without the availability of inexpensive surplus equipment, its modification for steerability, and the use of the sleeve to greatly reduce the opening forces, it is highly doubtful that the sport would ever have appealed to more than a few rugged individualists.



The deployment bag

The bag is like a pillow case and the canopy is S-folded inside of it. Bags can be found on both rounds and squares.

The Diaper is a low-weight, low-volume deployment device which wraps around the canopy and is locked with two or more line stows.



The slider: At the canopy and coming down

The Slider is a rectangle of cloth with a ring or grommet in each corner, each of which encircles one of the four groups of lines on the canopy. The slider slows the opening by staying up the lines near the canopy, restricting the canopy's size until it spreads to exert enough force to push the slider down. The slider works very well to ease the opening forces, while it is easy to pack and cheap to manufacture.

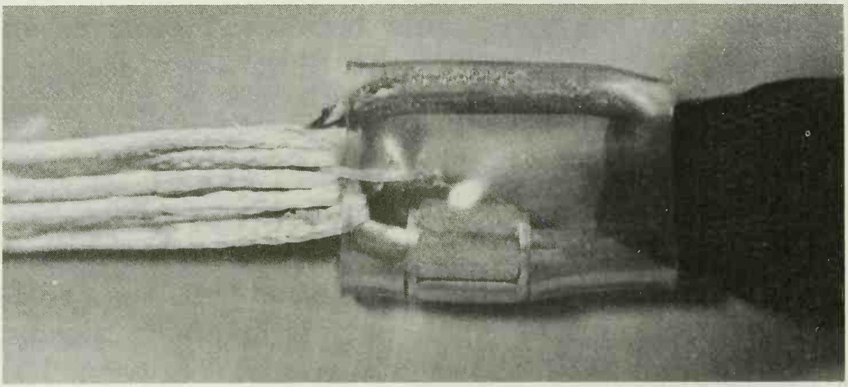
Sliders come in several designs. Some are solid and some have a hole in the center. *Split sliders* can be released to separate after opening. Accuracy jumpers like this feature, because it allows the canopy to spread a bit spanwise. A flattened canopy will turn slower and accuracy performance is otherwise improved. Canopy Relative Work (CRW) jumpers like the split slider because it removes an obstacle to their upward sight. Sliders are designed for individual canopies.

Snivels. New canopies usually inflate crisply. Older canopies may open more slowly or *snivel*. The trick is to distinguish a slow opening snivel from a no-opening streamer. Canopy fabric opens up, or becomes more *porous*, with use. It happens slowly, jump-by-jump, and snivels can start between 100 and 200 jumps. But age and use are not the only causes of canopy snivel.

If your ram-air canopy is sniveling, compare the line lengths. Compare each line with its opposite, on the other side of the canopy. The differences in length should not be more than one inch. Check the *slider stops* on the canopy. If any are broken or missing, the slider grommet could be hanging up on the fabric. Check the pilot chute. It should be at least 34" in diameter, unless the owner's manual says differently, and in good condition. If it is worn out, replace it. Any pilot chute with 500 jumps on it is probably too porous to do its job properly. The pilot chute must do more than just lift the canopy off your back: It tensions the canopy during deployment. Packing affects opening time. Check the owner's manual for the manufacturer's recommenda-

tions. If your openings are still slow, ask your rigger about ways to spread the nose during packing.

Check the *brake settings* against the owner's manual. If the brakes are set too deep, the canopy will open with the trailing edge farther down. See your rigger.



Slider bumper

Check the slider against the owner's manual. You may have an assembly problem. If the slider is the wrong size, it may be slow to come down the lines. When your canopy is new, the slider will probably come all the way down to the connector links. In fact, it may hit the links rather hard, damaging the slider's grommets; and rough grommets damage suspension lines. This is why connector links are usually covered with *slider bumpers* made of plastic tubing. Make sure the bumpers are secured in place with tacking thread. Check that the grommets are still firmly set in the reinforcement tape. Watch for tears in the fabric, broken stitch rows and loose reinforcement tape.

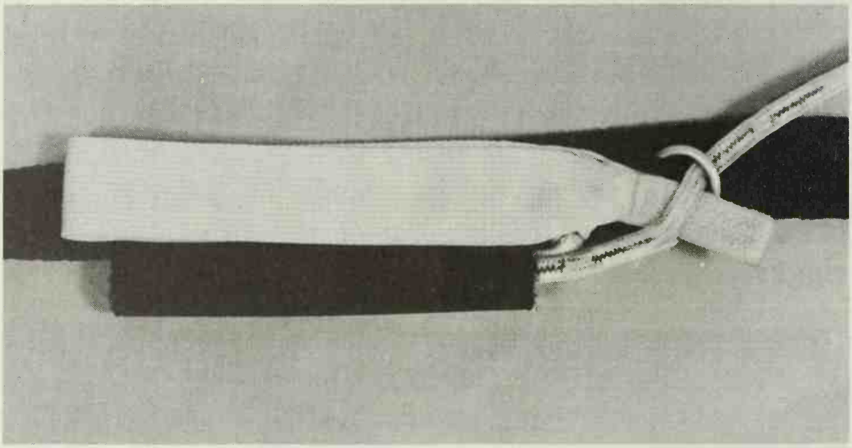
If your slider does not descend all the way down to the connector links at the top of the risers, pump the brakes to encourage it. Just pull both steering

If your slider does not descend all the way down to the connector links at the top of the risers, pump the brakes to encourage it. Just pull both steering lines all the way down and then let up. Repeat if necessary. Many jumpers like to pump the brakes in two-second cycles.

You may have your slider modified by cutting a hole in the center. A hole will decrease the drag, allowing the slider to start downward sooner and more easily. Modifying the slider should proceed in cautious steps. Start with a five inch diameter hole and gradually increase it to no more than ten inches. The optimum amount will depend on the original size of the slider. Some riggers make the slider smaller by sewing in a tuck. This modification may also restrict the spread of the lines. Ask your rigger.

Main canopy risers

The risers are pieces of webbing that connect the harness to the suspension lines. Years ago the risers were part of the harness and the lines were sewn directly to the risers. Now the lines are threaded onto connector links and the risers are fitted to the harness with metal riser releases. Main risers are sold with the harness, not the canopy, as both parts of the riser-release hardware must mate. Risers on sport parachutes are fitted with guide rings for the steering lines and toggles.



The brake set assembly

The brakes are set by pulling down on the steering lines and threading the toggle loops through the *control line locking loops*, or brake set loops. Then the toggle is seated on a Velcro strip on the riser, while the loose loop of line is stowed in a Velcro wrap pouch or in an elastic band on the connector link.

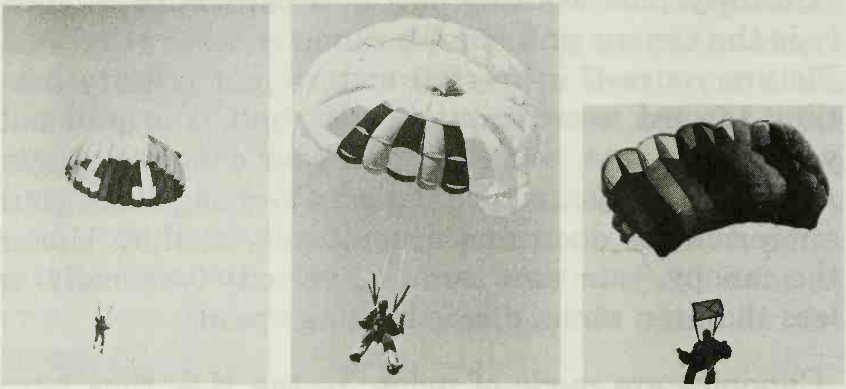
Check the brake set loops. This finger-trapped loop in the line must not be worn and the stitches must be secure. If a loop should break during opening, the canopy will surge forward on that side, will turn hard and may malfunction.

Canopy. The working part of a parachute assembly is the canopy and today's canopies work very well. Picture yourself in freefall at terminal velocity hurtling toward terra firma at 110 mph. You pull out your pilot chute, release it and your canopy deploys. At this point your weight doesn't change but your air resistance does, and dramatically at that. Under the canopy, your new terminal velocity (vertically) is less than ten mph., a safe landing speed.

Canopies are made of nylon; in the U.S. they have been since 1941, when the Japanese suddenly cut off the silk supply. Nylon turned out to be a better material than silk since it is elastic and resistant to mildew. In fact, nylon is resistant to almost everything, except sunlight and acid. Later, the entire parachute, including the container and harness was made of nylon, too.

There are many different weaves, weights, strengths and colors of nylon fabric available for parachute manufacture, because of the large sail industry in the United States. Other materials, such as Dacron, Spectra and Kevlar also offer some interesting possibilities. The parachute designers are trying them all.

Canopy types. Sport canopies can be divided into five general classifications: unmodified round (usually military surplus), modified round (military surplus or newly manufactured), Para-Commander class, single-surface wings, and ram-air. Only the ram-air *square* is common in the sport today.

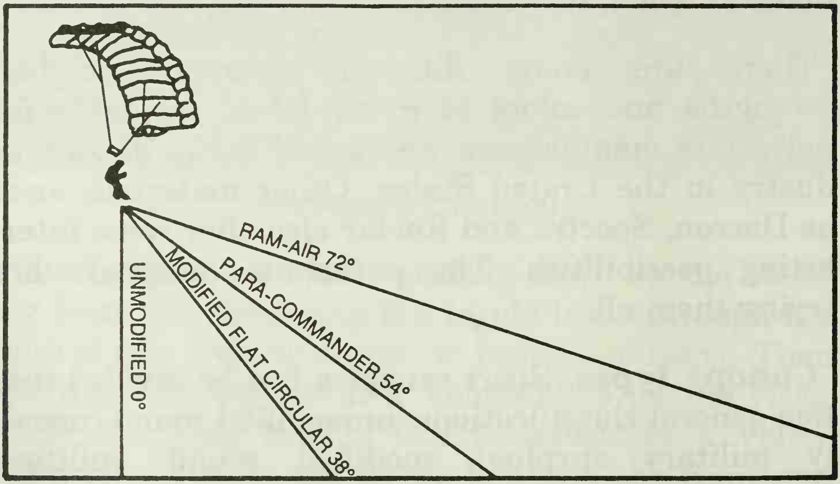


STANDARD ROUND 28' CANOPY
9 mph forward
18 fps down
38 degree glide

PC CLASS CANOPY
14 mph forward
16 fps down
54 degree glide

RAM-AIR CLASS CANOPY
20 mph forward
10 fps down (flarable)
72 degree glide

Performance figures are approximate and are for a 170 lb. person



Glide comparison in no wind

Round canopies. Modified round canopies glide at about 38 degrees. Cutting the holes larger, increasing the weight or using a smaller canopy results in greater descent and a correspondingly greater forward speed; the angle of glide remains the same.

With rounds or squares, changing the weight of the load, within reason, will not alter the glide angle of the canopy, but will change the descent and forward velocity. So a heavier jumper will descend faster and have a greater forward speed than a lighter one. However, an extremely light or heavy load may alter canopy shaping to the extent that performance is altered.

The Mark I Para-Commander

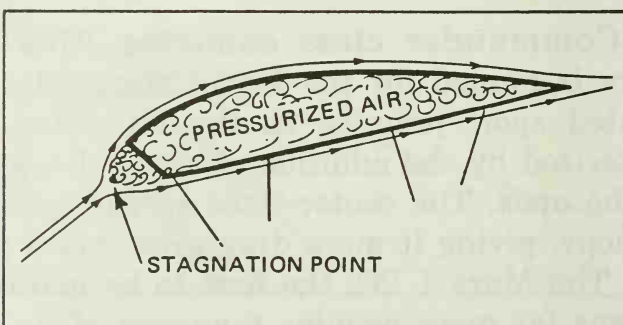
The Thunderbow

Para-Commander class canopies. This canopy category is named for the Para-Commander which dominated sport jumping in the late '60s, and is characterized by the addition of center lines to pull down the apex. The center lines spread and flatten the canopy, giving it more drag area and a smaller profile. The Mark I PC, the first to be marketed in 1964, was far more popular than any of its successors or competitors. Pioneer also built the Mark II, Competition model, Russian PC, RW PC, etc., while other manufacturers produced the Papillon, Cross-Bow, Starlite and others.

A round will get you down but a square will get you there.

The single surface Paradactyl canopy

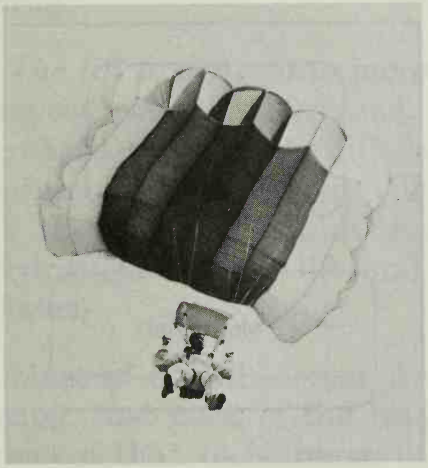
The wing class canopies are characterized by a single-surface airfoil, and are very low in both weight and volume. Their performance approaches that of the ram-air canopies. There were only a few wings, such as the Delta II ParaWing and the Paradactyl, made in any quantity but there may be more in the future.



Ram-inflation

Ram-air class canopies have a double surfaced configuration, which is inflated by the *relative wind* flowing into the leading edge of the canopy to produce an airfoil shape. The performance of the

square canopy is significantly better than round parachutes and they may be *flared* to make the landings very soft. It was Steve Snyder who put the ram-air principles, originally conceived by Domina Jalbert, to work and put the canopy on the market. Snyder designed the steering system, figured how to make the opening shock acceptable, and then taught classes to convince accuracy jumpers that up-wind approaches were superior to down-wind landings. That last part may seem obvious today, but it was revolutionary in the early seventies.



The Para-Plane

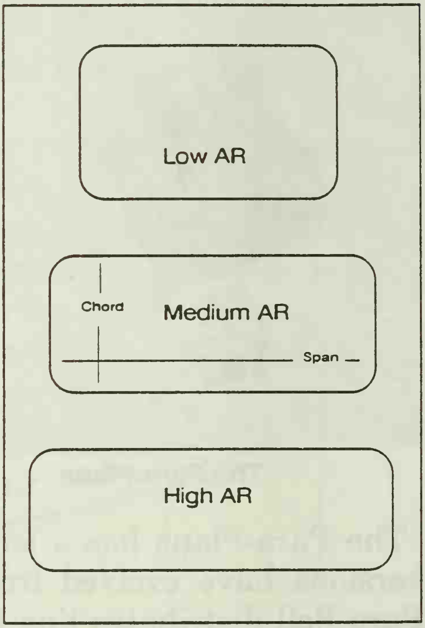
The Para-Foil

The Para-Plane has a smooth lower surface. Many versions have evolved from this basic design. The Para-Foil distributes line loads to the canopy with a *catenary* structure. Note the flares on the underside.

These higher performance canopies are closer to airplanes than they are to parachutes and have to be *flown* until the landing is completed. This is quite different from the standard flat circular canopy, which will bring you down safely even if you let go of the toggles and cover your head.

Canopy size selection depends upon the performance you want and your *exit weight*, your total weight including equipment when you leave the aircraft.

Jumpers wishing increased ram-air performance should switch to a smaller canopy. And if your canopy is too zippy, try a larger one. Smaller ram-air canopies with similar shapes have a greater rate of descent and forward speed, but their glide angle is still about 72 degrees.



Aspect ratio compares the chord with the span
(Precision Aerodynamics drawing)

See how the wings striking against the air hold up the heavy eagle in the thin upper air, near to the elements of fire. And likewise see how the air moving over the sea strikes against the bellying sails, making the loaded heavy ship run; so that by these demonstrative and definite reasons you may know that man with his great contrived wings, battling the resistant air and conquering it, can subject it and rise above it. - Leonardo daVinci

Aspect ratio (AR) is the *chord* (the distance from the leading edge to the trailing edge) measurement compared to the *span* (wing tip to wing tip) measurement of the canopy. More specifically, AR is the square of the span divided by the area and expressed as a ratio, such as 3:1. On a rectangular wing, AR is easier to figure, as it is simply the span divided by the chord. Higher aspect ratio canopies are said to have a *higher lift to drag ratio* or $^{L}/_{D}$ (called *L over D*). The higher the AR (shorter chord, longer span), the greater the lift for the existing drag.

The lift to drag ratio increases 8% for each unit the aspect ratio is increased. If the wing area is increased by 20%, the lift will increase 20%, and the minimum flying speed will be reduced by 9%. Speed is the most important element of lift: Double the flying speed, and lift and drag are increased four times.

Most of the lift comes from the top surface of the wing, just back of the leading edge, so it stands to reason that to increase lift, this surface should be enlarged. A greater span results in a more efficient canopy. Since square canopies are ram-air inflated and have no rigid members, there is a physical limit of about 3.5:1 to the aspect ratio. If the span is too wide, the canopy will experience deployment problems, and one tip will come around to kiss the other tip when the canopy folds in a fast turn. Since most of the *parasitic drag* in a canopy comes from the suspension lines, there is also a performance trade-off as the span is increased.

A high aspect ratio canopy will have a flatter glide angle, which you may or may not want. Generally,

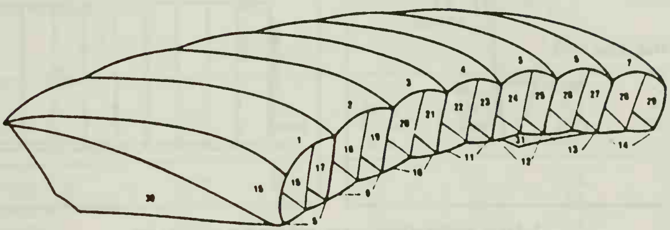
higher AR canopies will keep you in the air longer and will bring you back to the drop zone from a bad spot more often. But the flatter glide angle requires a flatter final approach and a longer landing area. If you love to nail the target, or you make a lot of demo jumps into tight areas, you may want a lower aspect ratio canopy. On the other hand, if you like relative work and jump where trees are few and far between, buy a higher aspect ratio canopy.

Number of cells. Most ram-air canopies have five, seven or nine double cells. For a given cell size, an increase in cells will provide an increase in aspect ratio. If the cells are smaller, the increased number will result in a smoother airfoil. But increasing the cells also increases the weight and volume of the canopy, due to added ribs and added lines. Suspension lines are combined, or *cascaded*, to reduce their number.

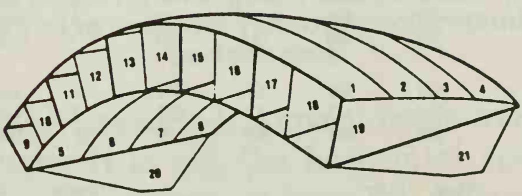
When square canopies took over from rounds, most were five cell. Actually, they had ten half-cells. The five cell ram-airs were lowest in weight and volume, while being easier to build. Next, the seven cell models became popular and the manufacturers figured ways to keep their weight and volume down, even though these models had more fabric, lines and seams. The next step was the nine cell canopy, which offered increased performance through a better airfoil shape maintenance.

Construction. Ram-air canopies may be constructed spanwise or chordwise. The traditional chordwise method ran a single width of fabric (often 36" wide) from the leading edge to the trailing edge. Now, by running the fabric spanwise from tip-to-tip, the cells can be wider than the width of the fabric.

Wider cells mean fewer ribs and lines, and that means a reduction in weight and volume, while fewer lines means less parasitic drag. Swift canopies from Para-Flite were the first to use spanwise construction.

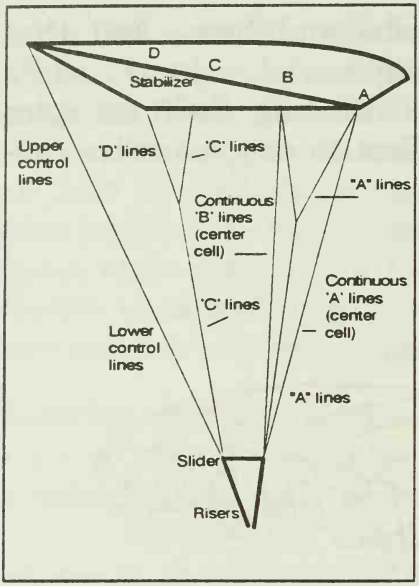


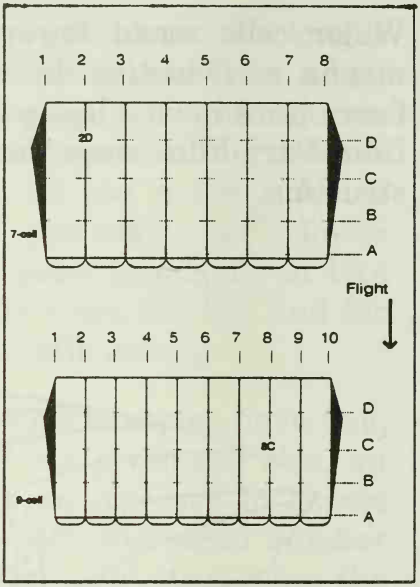
Chordwise construction



Spanwise construction

Fabric. Most ram-air canopies are made of very low permeability, ripstop nylon fabric. Weights of fabric are expressed in *ounces, per square yard* and common canopy fabrics weigh in at 1.1 oz. Generally, heavier fabrics will retain their low permeability longer.





Line attachment nomenclature

Precision Aerodynamics drawings

Canopy	Wing Area Sq. Ft.	Pack Vol. Cu. In.	Canopy Wt. lbs.	Max. Gross Wt. Lbs.	Number Cells	Airfoil Section	Span Feet
CRUISLITE XL	245	565	8.8	230	7	Lissaman 7808	21.3
CRUISLITE	220	476	7.8	215	7	Lissaman 7808	21.5
NIMBUS	225	537	8.2	215	9	Lissaman 7808	25.1
NIMBUS BETA	185	454	7.1	165	9	Lissaman 7808	22.3
STRATO CLOUD DELTA	240	569	9.2	220	7	PFI 6901	21.5
XL CLOUD	270	631	10.1	250	7	Lissaman 7808	21.5
DC-5	270	556	8.9	250	5	Lissaman 7808	21.5
PURSUIT	230	608	10.1	225	7	Lissaman 7808	21.5
SWIFT RESERVE	177	366	5.7	180	5	Lissaman 7808	18.5
CIRRUS RESERVE	230	443	7.0	220	5	Lissaman 7808	21.5
ORION RESERVE	220	440	8.8	215	7	Lissaman 7808	21.0

Canopy	Chord Feet	Aspect Ratio	Construction	Crossports	Canopy Fabric	Suspension Line	Reefing System
CRUISLITE XL	11.5	1:2.10	Chordwise	1	1.1 oz.**	600 lb. Dacron®	Slider
CRUISLITE	10.25	1:2.10	Chordwise	1	1.1 oz.**	400 lb. Dacron®	Slider
NIMBUS	8.9	1:2.82	Spanwise*	2	1.1 oz.**	400 lb. Dacron®	Slider
NIMBUS BETA	8.25	1:2.70	Spanwise*	2	1.1 oz.**	400 lb. Dacron®	Slider
STRATO CLOUD DELTA	11.3	1:1.90	Chordwise	1	1.1 oz.**	600 lb. Dacron®	Slider
XL CLOUD	12.6	1:1.70	Chordwise	1	1.1 oz.**	600 lb. Dacron®	Slider
DC-5	12.75	1:1.70	Spanwise*	1	1.1 oz.**	400 lb. Dacron®	Slider
PURSUIT	10.75	1:2.00	Spanwise*	3	1.1 oz.** 1.5 oz.**	600 lb. Dacron®	Slider
SWIFT RESERVE	9.6	1:1.93	Spanwise*	2	1.1 oz.**	400 lb. Dacron®	Slider
CIRRUS RESERVE	10.75	1:2.00	Spanwise*	2	1.1 oz.**	400 lb. Dacron®	Slider
ORION RESERVE	10.25	1:2.04	Spanwise*	2	1.1 oz.**	400/600 lb. Dacron®	Slider

Canopy specifications

	RATE OF DESCENT				GLIDE
	Full Glide fps	50% Brake fps	100% Brake fps	Proper Flared Land. fps	Approx. Ratio max. L/D
CRUISLITE XL	15-17	11-14	8-12	1-10	3. to 1
CRUISLITE	16-19	11-14	16-18	0-5	3. to 1
NIMBUS	15-17	11-14	8-12	0-10	3.2 to 1
NIMBUS BETA	15-17	11-14	8-12	0-10	3.2 to 1
STRATO CLOUD DELTA	12-16	10-14	10-14	0-10	3 to 1
XL CLOUD	15-17	10-14	8-12	0-10	3.2 to 1
DC-5	14-18	10-14	8-12	0-10	2.8 to 1
PURSUIT 230	15-17	9-11	8-10	1-5	3 to 1
SWIFT RESERVE	15-17	12-14	16-18	5-10	3 to 1
CIRRUS RESERVE	13-15	11-13	11-13	0-5	3 to 1
ORION RESERVE*	13-14	7-9	8-9	0-5	2.6 to 1

	SPEED RANGE				360° TURN RATE	
	Full Glide mph	50% Brake mph	100% Brake mph	Proper Flared Land. mph	Full Glide sec.	50% Brake sec.
CRUISLITE XL	25-30	12-15	3-6	0-5	3-5	3-5
CRUISLITE	25-30	13-16	4-7	0-4	3-4	3-4
NIMBUS	25-30	12-15	3-6	0-5	3-4	3-4
NIMBUS BETA	25-30	12-15	3-6	0-5	3-4	3-4
STRATO CLOUD DELTA	25-30	10-15	3-6	0-5	3-5	3-5
XL CLOUD	25-30	10-15	3-6	0-5	4-6	3-5
DC-5	25-30	10-15	2-4	0-5	4-6	3-5
PURSUIT 230	28-32	14-16	4-6	0-5	3-4	4
SWIFT RESERVE	20-30	13-18	0	0-5	5-6	5-8
CIRRUS RESERVE	24-27	10-15	2-5	0-5	4	6
ORION RESERVE*	20-22	14-16	8-10	0-5	3-5	3-5

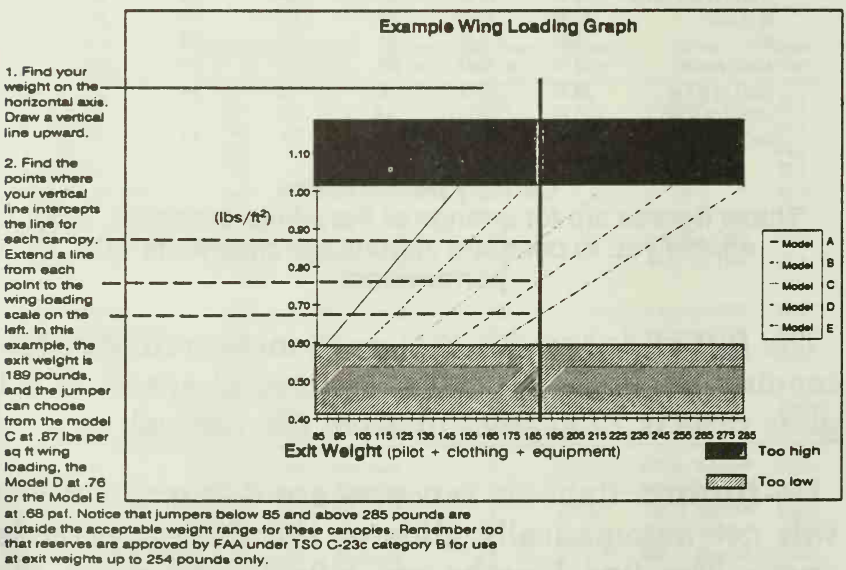
Canopy performance
These figures are for a range of Para-Flite canopies. They enable you to compare various specifications with performance.

The *full glide speed* is the speed measured at a descending angle. It is not the horizontal speed. A 3:1 glide ratio is 72 degrees up from the vertical.

De-tuning. Ram-air canopies are de-tuned so they will not automatically glide at the flattest possible angle. The line lengths are adjusted to angle the chord of the canopy to mid-range. If the leading edge were set higher for maximum glide, the canopy would be too easy to stall when you pulled the toggles down into deep brakes—a dangerous condition. The rule is: nose-up for glide, nose down for

stability. You can improve the glide of your canopy by pulling the toggles down to one-quarter brakes.

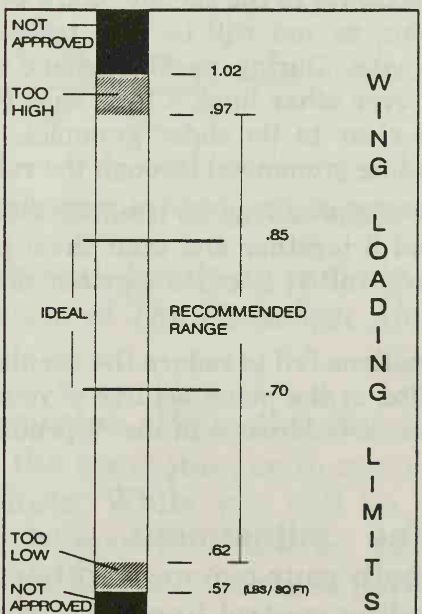
Sink rate is your descent speed expressed in feet per second. The lower your sink rate, the longer you will stay up. The easiest way to decrease your sink rate is to buy a larger canopy. If you want to experience a dramatic difference, borrow a large tandem canopy (built for two) and jump it solo. The larger canopy descends so slowly, you can even land it down-wind softly, though this is not recommended. So what is the trade-off? The sink rate is reduced but the glide angle remains the same, and this means the forward speed is also reduced. You may find yourself landing softly, but you may also back-up over the drop zone.



Wing loading graph
Precision Aerodynamics drawing

Wing loading compares your weight with the square footage of the canopy, and is expressed in *pounds per square foot*. Manufacturers design their

canopies for a certain weight range of jumpers. If your canopy is too small, it will be too zippy, both forward and down, and your landings will be hard. The canopy will stall at a higher speed and landings will have to be more precisely timed. Remember that the glide angle for a given aspect ratio is always the same, regardless of canopy size or your weight. If your canopy is too large, you won't have much forward speed and will be at the mercy of the wind. And of course, a larger canopy means more weight and volume when packed up. Most jumpers want lighter and smaller rigs, and tend to choose a canopy which is too small. Choose a canopy size that provides you with the most margin on either side. If you have to compromise, go larger. If you are jumping at higher elevations and/or if the weather is usually hot or humid where you jump, go larger.



Wing loading limits for an RW canopy.
Use a range of .50 to .65 for an Accuracy canopy.
Precision Aerodynamics drawing

Remember that you must compute your *exit weight*, the total weight of you and all your equipment. Using the above chart, if you weigh 150 lbs. and have 30 lbs. of equipment for a total of 180 lbs. and divide 180 by .77. This equation tells you your ideal canopy would be about 234 sq. ft. in area.

Opening shock reduction. Sometimes the opening forces are so hard, you do not look forward to pull time. Here are some suggestions from Para-Flite and others for reducing opening shock on a Pursuit canopy:

1. Change the deployment brake setting from 15" above the A-line attachments to 8". Just finger-trap new loops into the brake lines 7" above the current loops.

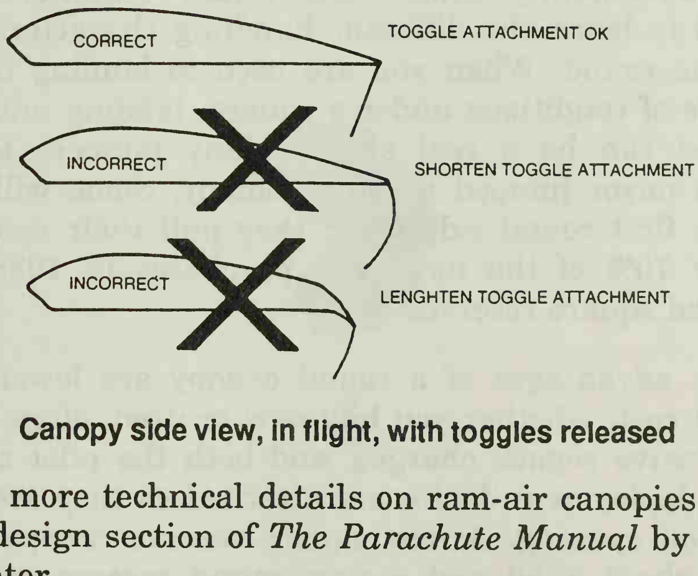
2. Stow the slider in a rubber band on one of the center cell "B" lines (number 4 or 5). Put the rubber band through the loop where the line attaches to the canopy. Mark the rubber-banded line with red ink, so you will be able to locate it when the rubber band breaks. During packing, make sure you do not stow the slider over other lines. Check that the line with the rubber band is clear to its slider grommet. Stuff the entire slider (not including grommets) through the rubber band.

3. Roll the nose of the canopy on itself. Roll the leading edges of cells 1, 2, and 3 together and stuff them inside the center cell, and similarly roll 7, 6 and 5 together and stuff them inside cell 4.

4. If these suggestions fail to reduce the opening shock enough, send to Para-Flite, or the manufacturer of your canopy, for *roll packing* instructions (addresses in the Appendix.)

Control line adjustment. See the owner's manuals for both your canopy and harness/container system, regarding control line adjustment. The problem is that the risers are provided by the harness/container manufacturer, not the canopy

manufacturer. The canopy manufacturer has no way of knowing what kind of riser release hardware you want, or what color your harness/container system is. The canopy manufacturer will mark the control lines to indicate the proper toggle attachment point for most standard length risers. Start with the attachment marks, jump the canopy and check the trailing edge of the canopy and the steering lines. The trailing edge of the canopy should lined up with the lower surface, and the control lines should be barely taut when the canopy is in full glide.



Canopy side view, in flight, with toggles released

For more technical details on ram-air canopies, see the design section of *The Parachute Manual* by Dan Poynter.

Reserve canopies. Both the law and common sense require the sport jumper to carry a second, or *reserve*, parachute. While you will be packing your own main, this reserve must be periodically inspected and repacked by a licensed parachute rigger. The reserve must not have a descent rate exceeding 25 feet per second, according to FAA regulations, and under 18 is a lot more comfortable.

Round or square? Student reserves may be round or square. The square reserve operates just like a square main except that the pilot chute, bridle and deployment bag are not tied on. The *free bag* on a ram-air is designed to allow the canopy to deploy even in a horseshoe condition.

Ram-air squares are more reliable than rounds and the argument goes; Why use a reserve that is less reliable and less maneuverable than your main? Square reserve canopies not only offer quicker openings, faster forward speed and greater maneuverability than rounds, they eliminate the need to learn the different handling characteristics of the round. When you are used to landing in all kinds of conditions under a square, landing under a round can be a real shock. Many jumpers today have never jumped a round canopy. Some will get their first round ride when they pull their reserve. Over 70% of the new gear purchases in 1988 included square reserves.

The advantages of a round canopy are lower up-front cost, whether you buy new or used, often less-expensive repack charges, and both the pilot chute and deployment device are attached so they are not *lost* on opening. A new square reserve canopy will run about $900 and a new round reserve canopy about $600 but a sprained ankle can run over $400 for x-rays and treatment; and you run a greater risk of injury every time you land under a round.

Most jumpers are buying canopies 15 to 30 square feet too small for their weight and experience. - Bill Dause

CRW jumpers often prefer a round reserve, as it provides a *canopy transfer* option. If a collision should damage or deform your main canopy at a low altitude, you might not wish to break away to deploy your reserve. An alternative would be to pull the reserve, drag it full of air and then jettison the main. Canopy transfers only work when the damaged main is flying straight and has some forward speed. Canopy transfers should not be attempted with a square reserve, as it will probably fly into or around the main.

A round canopy with a partial inversion malfunction

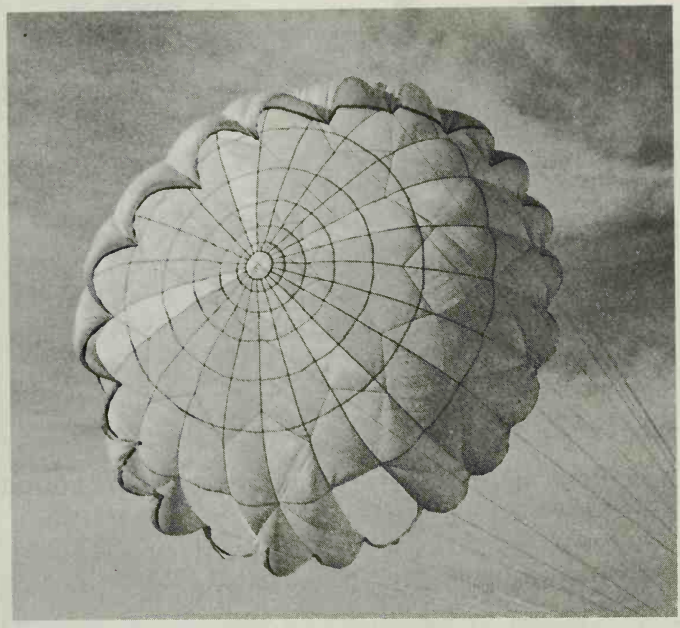
The main problem with round canopies is reliability. Rounds malfunction a very high percentage of the time. Round malfunctions range from complete inversions, to partial inversions, to temporary partial inversions. Then there are the broken lines, burned fabric and blown panels. The *complete*

inversions happen so quickly they are rarely seen. Most jumpers do not realize they have a complete inversion until they look up to see the pilot chute dangling down from the apex on the *inside* of the canopy. Then they discover the steerability holes are in front and the lines or risers are twisted. *Partial inversions* take on a brassiere or *Mae West* configuration. The result is a significantly higher rate of uncontrollable descent.

Blown panel as a result of a temporary partial inversion

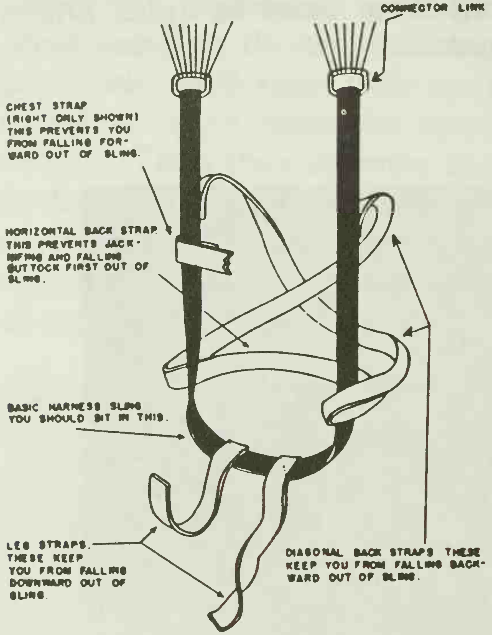
Temporary partial inversions occur during opening when the canopy starts into an inversion, and then changes its mind and reinflates properly. As the inflating canopy rebounds, it starts out under the lower lateral band of the canopy. On its way back, the speed and pressure of nylon on nylon between the apex of the canopy and the lower lateral band sear or burn them both. The temporary partial inversion usually happens so fast, no one notices until the canopy is inspected during repacking. The inversion is revealed by a telltale pattern of burns. Sometimes, when the lop-sided canopy fully inflates, the opening shock bursts the seared fabric in the canopy, and the lower lateral band breaks. The

result is a canopy split from skirt to apex, and a very high rate of descent.



A modified 26' conical surplus canopy

If you still want a round reserve, here are a few things to help you make a selection. Do not buy military surplus. Purchase only one of the newly manufactured sport reserve canopies. Generally, if you weigh less than 150 lbs., you may use a 24' canopy, if less than 200 lbs., a 26', and if you are heavier, get a 28-footer, but be sure to check the manufacturer's recommendations. A somewhat smaller canopy may be used, if made of lower permeability fabric and/or designed with a higher drag shape.



Basic harness sling with supporting straps added

The harness is an arrangement of nylon straps, designed to conform to the shape of the body, in order to attach it to the canopy for distribution of the opening forces as comfortably as possible. The harness is designed around a sling which takes the greatest part of the opening load. The other straps are added only to keep the jumper from falling out of the basic sling. In fact, the diagonal back straps, for example, take only about 15% of the opening force. Sport saddles may be solid or split, and all are very well padded.

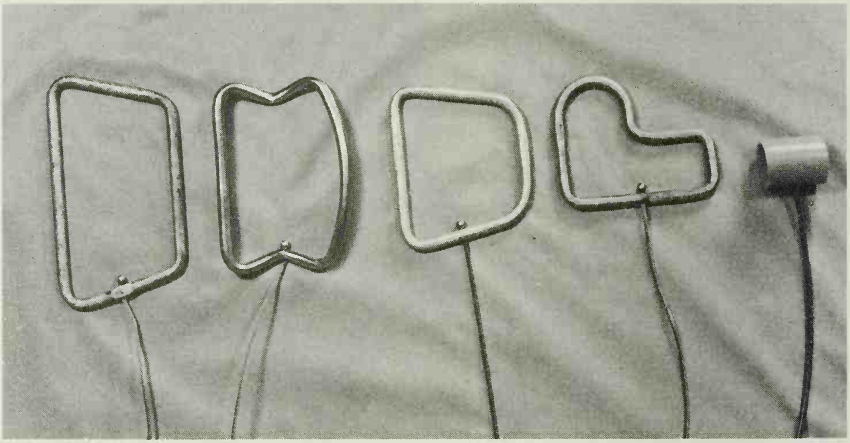
The container, or *pack*, encloses the canopy and the deployment device and is locked closed by ripcord pins or cables through one or more cones or loops and grommets. Containers are employed for both main and reserve canopies and may be mounted together on the back with the reserve con-

tainer on top and the main container on the bottom, or separately with the main container on the back and the reserve container on the chest.

The Talon piggyback container system with throw-out pilot chute

The *packtray* is the line stow panel in the base of the container. When a deployment device is being used, the lines are usually stowed on the device rather than in the packtray. The container is often cut on the bias, 45 degrees to the weave of the fabric, to permit a bit of stretch during closing. Containers are not structural members of the parachute assembly; they simply attach to the harness and hold the canopy.

Container design is simply a question of packaging; where to put so many cubic inches of canopy. All the inside forces pushing out make the container want to assume a spherical shape, so some outside forces are needed to push the container back in, to compress the canopy. Tailoring, frames, bows, pack opening bands, and other devices are sometimes used. Reserves often use locking loops through the center of the pack. Many main canopies are pre-compressed inside a deployment bag and their (throw-out) pilot chute is stowed outside the container; the result is a smaller, thinner pack.



Ripcords come in many sizes and shapes

The ripcord is a locking device which secures the closed parachute container; it does not open the pack, it simply releases it. The ripcord assembly may consist of a tubular metal handle (there are many shapes and materials to choose from), a cable of 3/32" diameter, 920 lb. stainless steel, the applicable number of properly spaced pins and a device to attach the cable to the handle, such as a swaged (pressed on) terminal ball. Or the grip may be a soft foam-stuffed handle or a plastic tube connected to a

Teflon coated cable. One ripcord assembly will activate the main parachute (except for rigs with throw-out or pull-out pilot chutes) and another will activate the reserve.

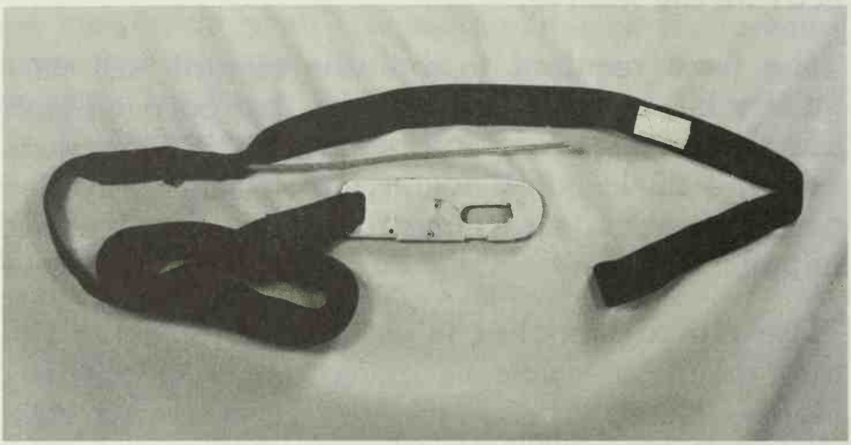
The force required to pull the ripcord will vary quite a bit, not only between rigs, but between pack jobs on the same rig; you can expect it to be between five and 22 lbs. Pull-out and throw-out activation devices on main parachutes are usually much easier to pull.

The ripcord pocket is designed to hold the ripcord in an accessible position. It may be made of fabric, elastic webbing, Velcro® closure or a steel clip and, if of fabric, it may receive its gripping quality from Velcro tape, an internal elastic cord or coil steel spring. Certain pockets are made to be compatible with certain ripcord handles; parts are not interchangeable.

Pull-out pilot chutes are stowed inside the container and throw-out pilot chutes are stowed in pouches. Some pouches are split and closed with Velcro, some have elastic around their mouth, and others are made of a stretch material such as Spandex so the pilot chute can't hang up in them.

The static line is a way of attaching the *ripcord* to the aircraft so that the parachute will be automatically activated as the jumper falls away. It consists of a special locking snap fastener, heavy webbing and a cable, sometimes with pins. Pin type static lines must be routed through a guide ring on the container.

With the direct bag system the arrangement is somewhat different. The deployment bag is attached to the static line and stays with the aircraft.



The static line

On static-line jumps, the main ripcord is replaced with a dummy ripcord handle, so that the student may make Practice RipCord Pulls (PRCP). A dummy handle looks like the real one, but is fitted with a brightly colored *flag* so that the jumpmaster can see when it has been pulled. The handle is also fitted with a strip of Velcro to provide resistance similar to that felt in pulling the pin or cable from the locking loop. You must pull the handle from its pocket, and then continue pulling to separate the Velcro.

Hardware. Most of the metal fittings on the parachute are made of forged steel, plated with cadmium to resist rusting.

Canopy releases were originally designed for the jettisoning of the canopy to avoid dragging in high winds, but sport jumpers adapted them for the breakaway reserve procedure. The older two-button and cable models made for the military by the

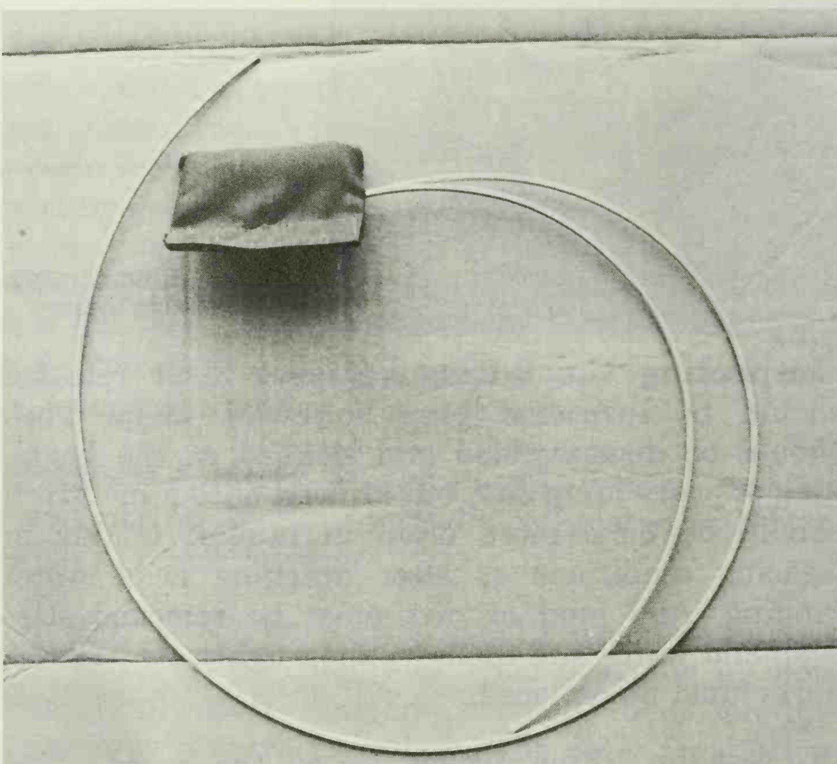
Capewell Manufacturing Co. in Hartford, Connecticut, were later modified or replaced, because they had a tendency to hang up and occasionally caught a deploying pilot chute from a chest-mounted reserve. Now the Capewell release has been replaced by specially designed sport hardware, mostly 3-Ring releases.

The 3-Ring canopy release in use

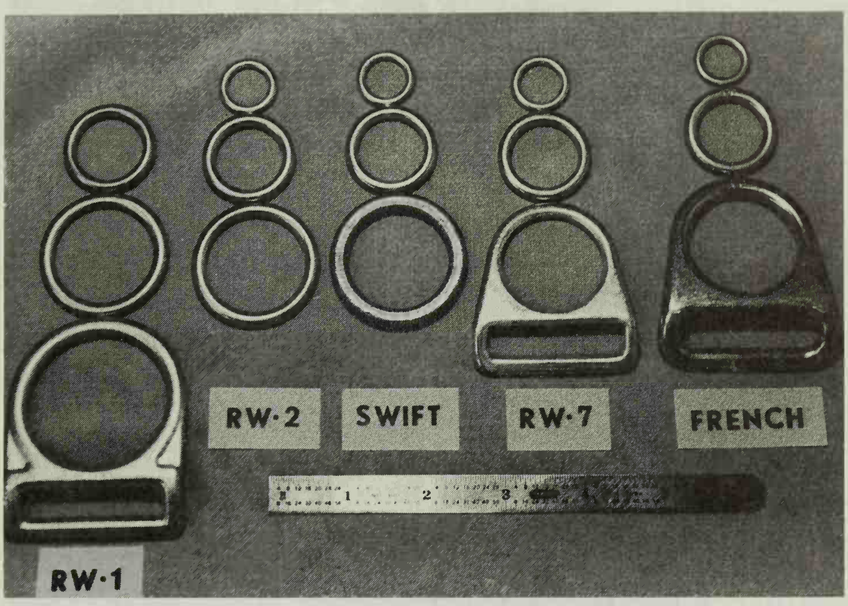
Inspecting the 3-Ring release. Riser releases should be inspected prior to every jump. They should be disassembled and cleaned at the beginning of every jump day, but at least once a month. It should be done more often in humid, muddy or freezing conditions or after dragging or a water landing. Any mud or dirt must be removed. Use soap and water and then dry thoroughly. Any rusted parts must be replaced.

To test the 3-Ring release, secure the risers to the packed rig with their cover flaps or two strips of

tape. Freezer tape works well because it won't leave adhesive on the nylon. Taping the risers insures they won't twist during your inspection. Position yourself behind the rig, reach around and grasp the breakaway handle. Pull the handle slowly to arm's length. Some cable may remain in the housing but both risers should release simultaneously. If one side releases before the other, the breakaway handle assembly may have been built for another harness. If both risers do not release at the same time, tell your rigger. He or she will recheck the cables and may be able to correctly adjust the lengths by cutting and searing the longer one. Make sure the cable tips are smooth and tapered or they will catch on and fray the release loops when pulled through.

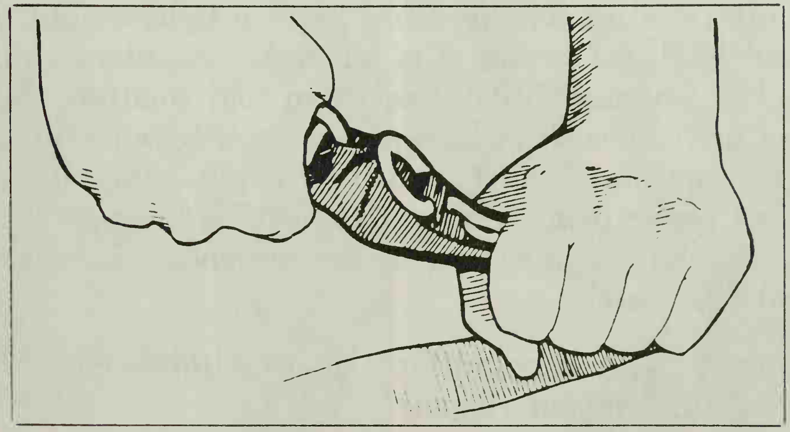


3-Ring release handle and cables



Rings come in different configurations and sizes

The white locking loop that holds the smaller top ring must be flexible. Flex the loop to soften it and inspect it for wear. If it is stiff or dirty, use soap and water to clean and soften it.



Twist each riser

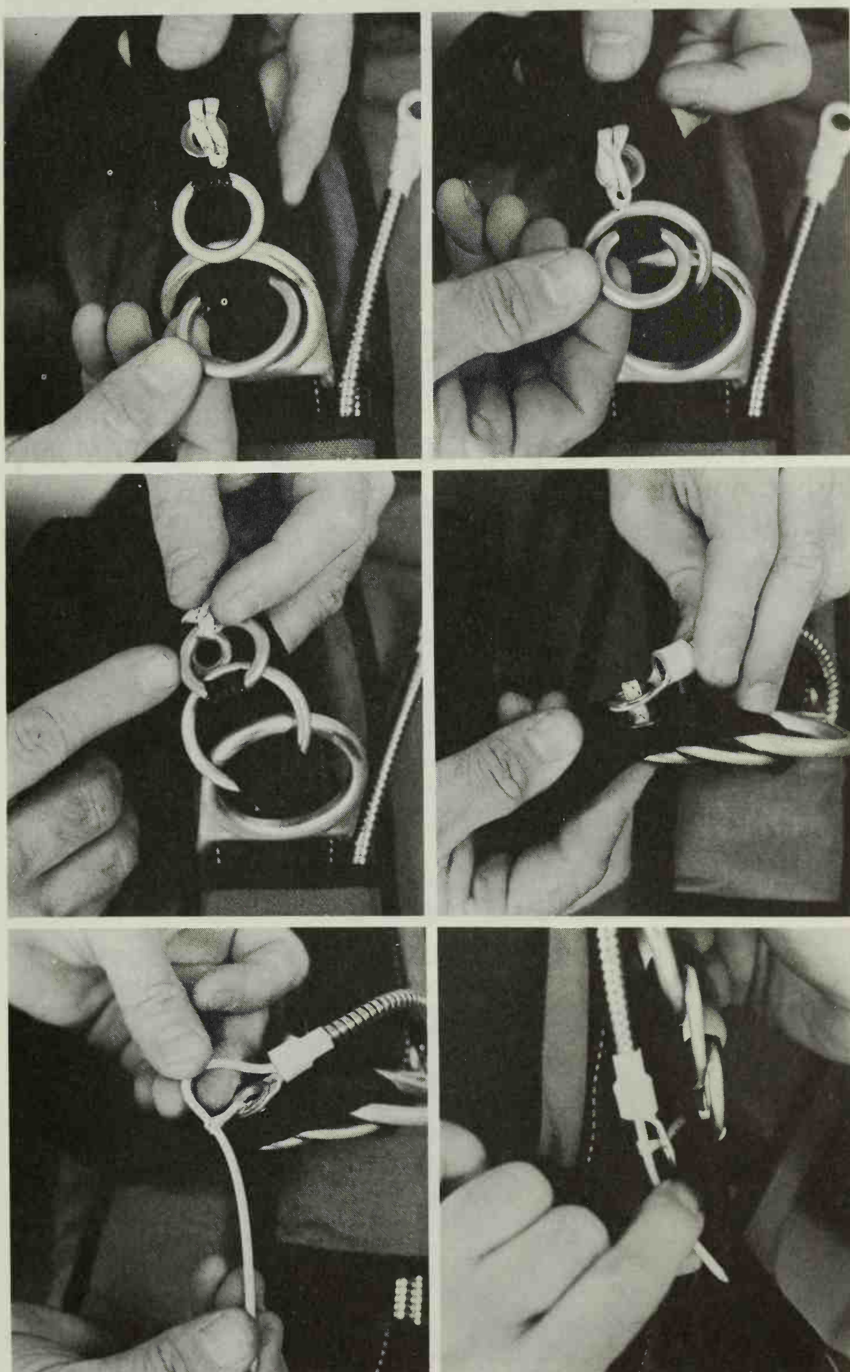
Grasp each riser to twist and flex the webbing near where it passes through each ring to remove any *set* or deformation in the webbing.

Check the Velcro on the release handle and main lift web. Make sure it is clean and holding well. Now, inspect the stitching that holds the large ring to the harness. If the large ring is stamped RW-1-82 or RW-1-83, contact your rigger or the manufacturer. Some of these rings were part of a bad batch: Not properly heat treated, they are subject to deformation under high loads. A deformed ring will probably hang up. They must be tested and may have to be replaced. A previously tested ring should be marked, often with a lead seal on one side.

Pull downward on the housings. They should not move down more than 1/2" but should be free to move upwards one to two inches. The Racer is an exception, so check your owner's manual. Check the terminal fittings at the ends of the housings. Make sure they are secure. Run the cables back and forth through the housings. Check for dents and obstructions.

Lightly lubricate the cables with a light-weight oil such as *3-in-1* brand. Too much oil will attract dirt and grit or may become tacky in cold weather. Just run the cables through a paper towel to wipe off old accumulations of dirt, and then apply some oil to a clean paper towel and run the cables through it. A silicone-based lubricant is recommended in desert and dusty areas.

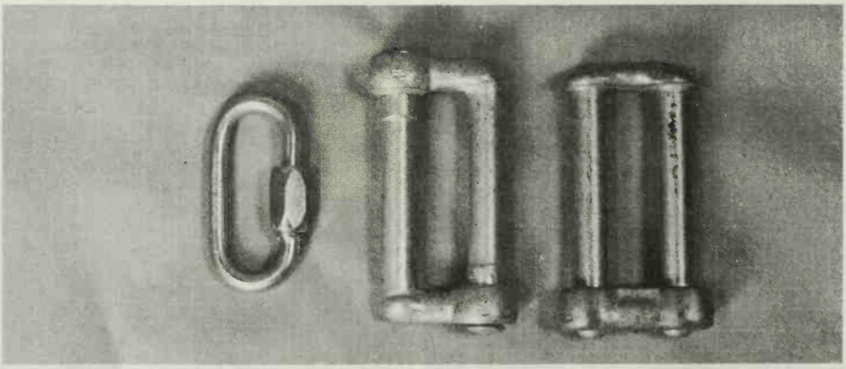
Cables with any surface deformation should be replaced. See your rigger.



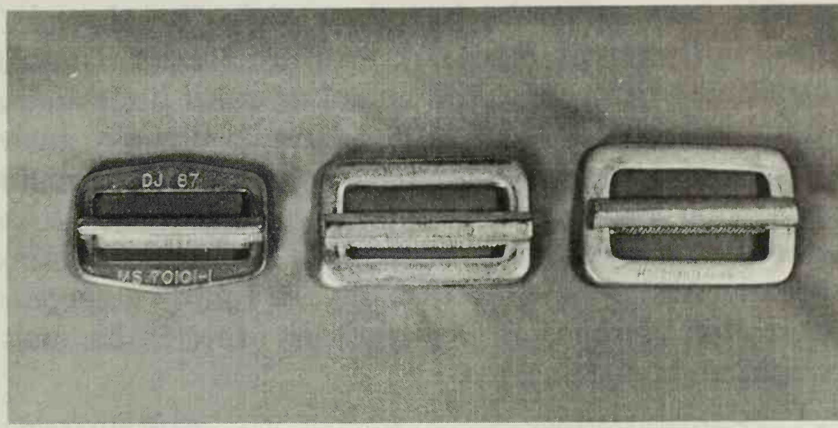
Assembling the 3-Ring release

Now reassemble the system, making sure the risers are not reversed. Put the middle ring under the base ring and flip it through. Place the small ring under the middle ring and flip it through. Put the loop over the small ring only, then thread it through the grommet in the riser to the back side. Thread the loop through the terminal end of the cable housing. Now pull the cable through the loop and stow it in the cloth channel on the back of the riser. Check your work. On the top: The loop goes over the top, smallest ring only. The middle ring must not be caught on the loop at all. On the back: The loop must not be twisted. The cable must run out of the cable housing, through the loop and into the riser channel.

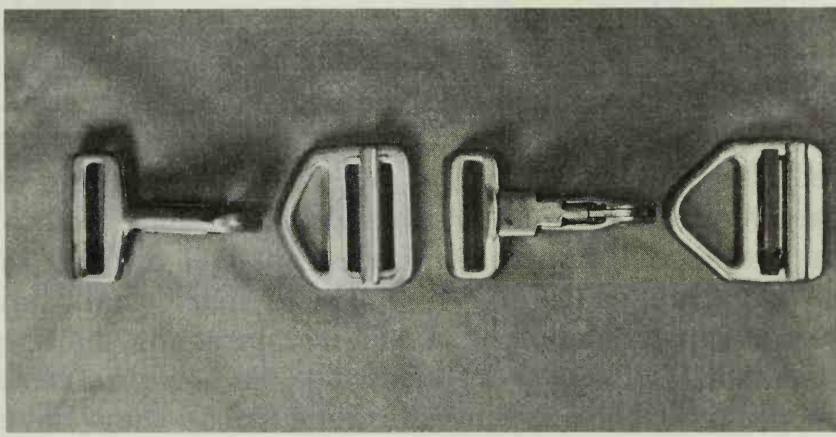
Remove the tape holding the risers in place. If you find any wear or other problems, consult your rigger or the manufacturer.



Connector links: L-R: Rapide link, 3000# Army separable link, 3000# Navy speed link



Friction adapters: L-R: 500 # light, 2500# shallow, 2500# deep



Snaps and rings: L-R: 2500# Air Force snap, shallow adjustable "V" ring, Navy quick ejector snap, deep adjustable "V" ring

Rapide links. The more common connector link today is the Rapide link or *French Connector*. The Rapide link is favored over the older military *L-bar,* separable and speed links because they are smaller, lighter, easier to use, less expensive and do not rotate in the riser. Unscrewed, the Rapide link will fail under a very light load. They must be checked regularly to make sure the barrel is screwed on completely. Conversely, they must not be over-tightened

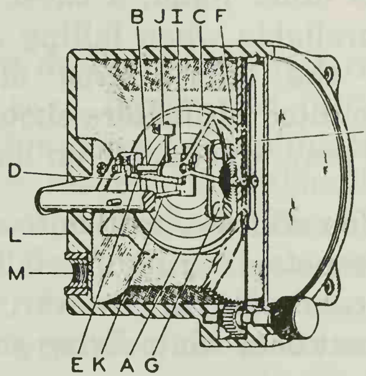
as this may split the barrel or strip the threads. Check the barrel regularly for tiny cracks. Install the Rapide link, twist the barrel on until hand-tight and then add 1/4 turn with a wrench (for five inch pounds of torque). Though the end of the link is peened to retard over-tightening, sometimes it is possible to screw the barrel off the ends of the threads. Make sure the threads are totally engaged. After ten jumps or so, recheck the links and retighten, if necessary.

Instruments. There are four ways to determine when you have reached pull altitude; stopwatch, altimeter (visual or audible), counting the seconds and eyeballing the ground. *Eyeballing* is a good backup, but it isn't accurate when you are trying to locate a 2,500' mark in the sky. Depth perception is greatly reduced over water and at night. And eyeballing is rarely accurate at an unfamiliar drop zone. *Counting* works well on fives and tens, but it is difficult to be accurate in timing freefalls of more than ten seconds in this manner. USPA recommends the use of a *visual altimeter* on all jumps. *Audio altimeters* should not be used by students until they have demonstrated a satisfactory level of *altitude awareness*. And they should be used by experienced jumpers only as reminders to check the visual altimeter or the ground.

The altimeter has an evacuated chamber called an *aneroid*, which is very sensitive to changes in air pressure. As you descend, the air pressure increases since the air gets thicker, and the aneroid bends inward. This aneroid movement is relayed and amplified through a series of gears, and the result is indicated by a needle on the face of the instrument.

The sport altimeters are much smaller and lighter than the standard aircraft equipment. All mechanical devices are subject to failure, so you should always check your altimeter against another one. Compare them when you are climbing for altitude; check yours against a friend's or the one in the instrument panel of the jumpship. But be careful; your altimeter is set for *ground level* and the aircraft's altimeter may be set for *sea level*.

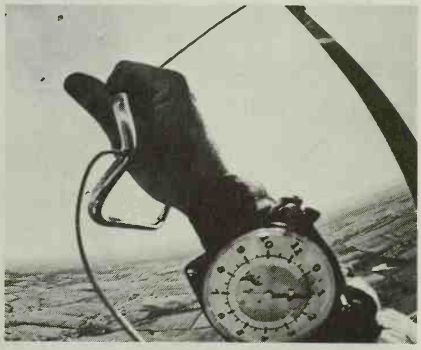
The parts of the altimeter.
A. Aneroid, an evacuated diaphram
B. Rocking shaft assembly
C. Sector gear
D. Calibration arm
E. Diaphram connecting link
F. Handstaff
G. Hairspring
H. Needle
I. Temperature compensator
J. Counterweight
K. Diaphram stop pin
L. Case
M. Opening in case.



The altimeter operates on an aneroid which is sensitive to changes in air pressure

The altimeter is *zeroed* on the ground to calibrate it. If you are planning a demo jump off the DZ, you will have to find the elevation of the landing area and compensate for it by adjusting the altimeter.

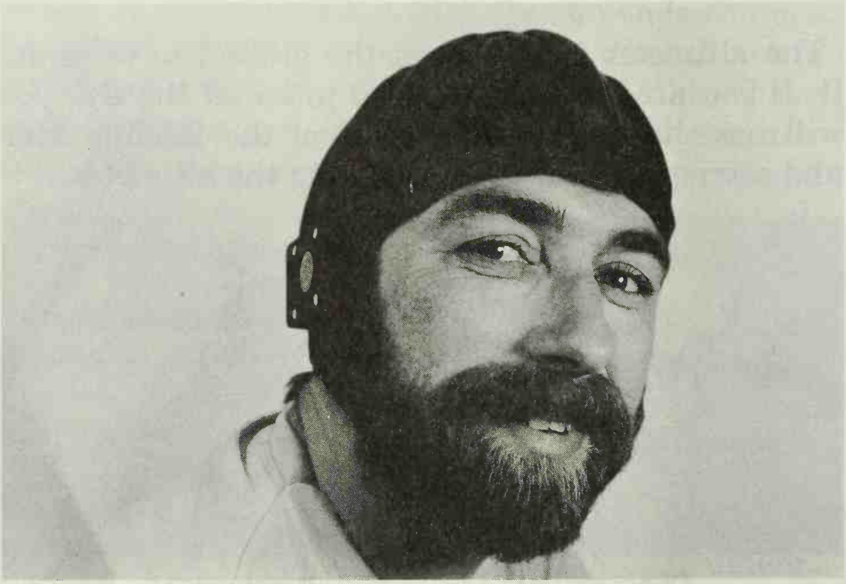
Chest mount



Wrist mount

The instruments may be mounted on your chest or other harness strap, or on your wrist. Many people prefer a fixed mount over the wrist mount, reasoning that you can't fly as well if you are constantly pulling in a flying surface (wrist) to see what your altitude is. Another argument for the fixed mount is that jumpers sometimes have had their wrist-mounted altimeters ripped off in relative work. On the other hand, a chest mounted altimeter may be unreliable when falling on your back (SDB) as it is in the burble area of reduced pressure. Wrist mounted altimeters should be worn on the left wrist so they won't catch on hand-deployed pilot chutes.

You will not be able to see much movement in your altimeter during freefall until you graduate to 20 second delays. However, you will use the altimeter a great deal while flying your canopy.



The Dytter audio altimeter

Audio altimeters, sometimes called *beepers* or *dirt alerts*, go beep, beep, beep in your ear at a pre-set altitude above the drop zone. The Paralert has a sensor and a speaker to mount inside the helmet, while the Dytter is a single unit designed to be mounted on the helmet near the ear.

Never put your trust in just one method of altitude assessment and remember, *when in doubt, whip it out!*

The automatic activation device (AAD) is a ripcord release which combines a barometric device (similar to an altimeter) with a means of pulling the ripcord of the main or the reserve. Additionally, some have a sensing mechanism which switches the opener on and off, so that it fires only if the wearer is descending through 1,000 feet at a high rate of speed; there is no need to turn the release on and off. This sensing mechanism saves wear and tear on the release, which would otherwise fire if you forgot to turn it off after opening.

The USPA requires AADs to be mounted on the main or reserve of all students, since statistics show that the devices might cut the fatality rate as much as 50%. Experienced jumpers can make their own decision. But everyone, particularly students, must realize that the AAD is only a back-up system; mechanical devices can fail and should not be relied upon.

USPA has never received a report of a jumper being killed because of an AAD misfiring; we do, however, have many reports on file in which AADs saved lives. - Parachutist Magazine

There are two reasons many experienced skydivers do not use an automatic activation device. The first is the $700 cost. The second is the fear of premature, accidental release; and they do fire at the wrong times occasionally. A premature firing on the ground can be aggravating; a premature firing in the aircraft can be dangerous. Make sure the sensing unit of your AAD is located properly. If it is mounted in the center of your chest, and you go over on your back (SDB), the sensor may be in a burble area of reduced pressure and may not sense the altitude accurately.

Do not drop an AAD-equipped rig. The sensor contains a delicate lever arm which may be damaged in rough handling. Protect the AAD from moisture and dirt. Both the sensor and power boxes contain sensitive valves and metering devices.

There is only one type of automatic release common in North America, the FXC Model 12,000. The Sentinel was very popular in the '60s and '70s through the mid-'80s. While it has been withdrawn from the market, many are still in use. Czech and Soviet models of the KAP-3 are used in Eastern Europe.

Just looking at the individual fatalities that occurred this year, 11 of the 28 might have lived had they been equipped with a functioning automatic activation device. - Paul Sitter

The FXC Model 12000

The FXC Model 12000 is barometric, has a rate of descent sensor, and pulls the ripcord pins with a spring loaded cable. The activation altitude is preset on the ground and AAD will only fire if the jumper passes through that altitude at a rate faster than 40-60 feet per second, about one-third of terminal. Since good canopies descend at less than 10 feet per second, the AAD won't fire unless there is a problem. The Model 12000 may be mounted on either the main or the reserve.

Personal equipment. Jumpsuit, helmet, boots, goggles, a knife and gloves are some of the personal equipment you will want to consider.

1920 & '30s Barnstormer. This one used two parachutes, most did not.

1940s and 1950s. Military jumper. They used football helmets at first.

1960s. Sport jumpers used much borrowed military gear and some designed for the sport.

Early 1970s, The sport jumper's gear is all specially designed for flying and most suits were bigger

1980s, The sport jumper opted for tighter suits to provide greater descent speed for more control

Jumpsuit. A parachutist's outer garment was called *coveralls* in the early sixties and that was what it was designed to do; provide warmth and protection and keep the clothes clean. Into the seventies, it became a *jumpsuit*, no longer store-bought, it was well-tailored, fancy, custom-made, specialized equipment. In the mid-seventies, with the great interest in relative work, the garments became bigger and were dubbed flying suits. And some flying suits were huge! They had a lot of extra fabric under the arms, and cords inside to hook over the thumb so that you could pull the suit out by extending your arms. They had great flared bells on the arms and legs, and there was enough room inside for the whole team. The reason for all this cloth was for *range;* the relative worker wanted to be able to go faster or slower and to accelerate and decelerate more rapidly. Some jumpers didn't notice their jumpsuits were too large until they reached two-grand and found their sleeve was covering their rip-cord hand. In the mid-eighties, relative work teams switched to skin-tight jumpsuits which provided a faster rate of fall. With all of them falling faster, they tended to stay on the same level in transitions, so transitions became quicker.

Sure-grips are rib-like handles added to the arms and legs of the jumpsuit so that team members can get a grip on you. Grippers have become more important now that jumpsuits are so tight.

> *Choose a suit to match the fall rate of the people with whom you are jumping.* - Pat Schraufnagel

Traditionally, jumpsuits were made of heavy or light cotton. Newer jumpsuits are often made of synthetics or a poly/cotton blend. Some of the synthetics, such as the elastic Spandex, may melt if they come into contact with power lines. And some synthetics will not only melt, but burn.

Helmet. You will need a helmet to protect your head during rushed relative work exits, in freefall with colliding jumpers, during opening to save the ears from errant connector links, and while landing. Make sure the helmet is well-constructed, has a secure strap (not just a snap), does not restrict your vision or hearing, and is cut high in the back so you can get your head back to look up in freefall.

Goggles. The main reason for wearing goggles is to keep your eyes from watering up. But goggles will also ward off some of the small things flying around at altitude, which would injure your eye. You may not bother with goggles on static line; someone else will be spotting and you won't be in the fast air very long. But you cannot perform safe, competent relative work unless you can see clearly. Some jumpers suffer more from eye tearing than others. You will have to test yourself to find out.

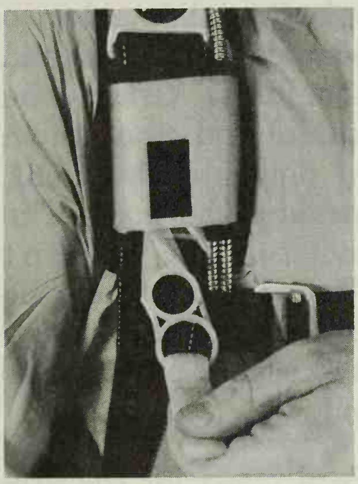
Be wary of large rubber goggles with wide frames. They restrict the peripheral vision and make it difficult to locate the ripcord. Big goggles also have a tendency to blow off in freefall. If you wear glasses, there are goggles which will fit over them, or you may prefer to wear only the glasses secured with an eyeglass strap. Get goggles with clear lenses only, and steer away from the other "flavors." You will need all the light you can find when jumping late in

the day. Most visors and face shields are out, they often blow off in freefall.

Gloves provide warmth and protection for your hands; they should be worn if the temperature at jump altitude is below 40 degrees Fahrenheit. And remember, as you climb, that the temperature drops at a rate of about 3.7 degrees per thousand feet. That is 37 degrees less at 10,000' than at ground level, it adds up fast. Gloves should be as thin as the temperature will allow, and you should use them when practicing your ripcord pulls and reserve procedure.

Boots. In the early days of sport parachuting, everyone wore Army boots just like the airborne troops without realizing that their missions were quite different. The paratroops use the parachute for transportation, a means to an end. The sport jumper is interested only in the means, and has no intention of following the jump with a 40-mile *problem*. Throughout the sixties, most jumpers wore the imported French Paraboot which has a thick pneumatic sole, good ankle support, and fit well if you had European feet. Later, as square canopies took over, most jumpers switched to lighter footgear, usually running shoes. Boots with lacing hooks are absolutely out. They could catch a pilot chute, suspension line, or deploying canopy.

Some old timers remember the helmetless skydiver who survived a night landing onto a roof in Antioch, but died from head injuries suffered when she fell off the roof. - Eric Roberts



A hook knife is designed to cut suspension lines in an emergency

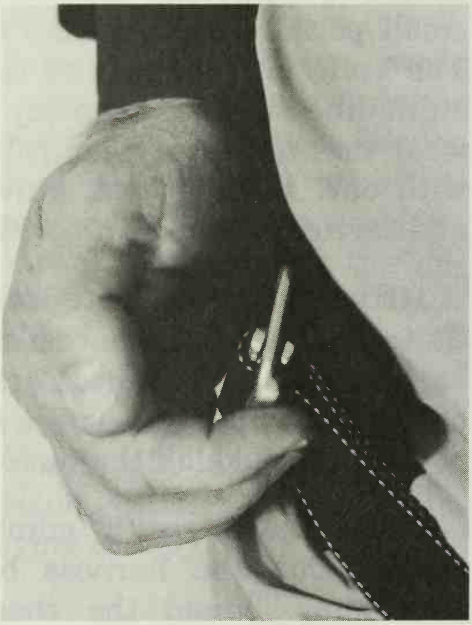
Hook knife. A small, open, accessible hook knife should be carried, preferably on the harness. A small pocket with a Velcro closure is a good place. The knife may be used to cut suspension lines and static lines in an emergency. Every skydiver should wear one and every jumpship should be equipped with one. Folding hook knives should be protected and carried in the open position.

Fitting the parachute assembly. Proper harness fit and adjustment are essential for comfort, as well as good flying. Few skydivers understand the fitting of the parachute and yet it is so very important. A poor fit can take all the fun out of the jump.

Loosen the back (if adjustable), chest and leg straps. Don the harness by placing it over the shoulders. Thread the chest strap but do NOT tighten. Bend over at the waist, reach under the pack and push it up over the shoulders. Then slide the saddle down over the buttocks, making sure the leg straps are not misrouted. Hook up the leg straps and tighten them. If you have a solid (not split) saddle, make sure it is positioned well under the but-

tocks. Adjust the main lift webs (if adjustable) so that the canopy release hardware is located in and above the hollow of the shoulders. Grasp the diagonal back straps (if adjustable) and cinch them down. Pull them forward and down to the front, until the harness feels snug around the body. The harness should be snug, but not so tight you can't walk. Adjust the chest strap. Thread and tighten the belly band, if you have one. Stow all excess webbing in the strap channels or elastic keepers provided so that they do not flap in the wind.

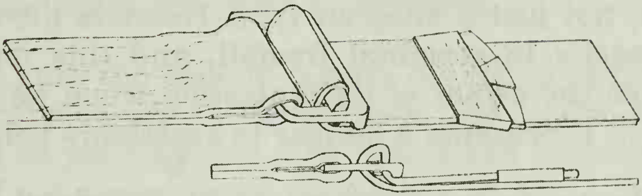
Now your gear is on and you are ready for the pre-boarding equipment check.



To loosen the web, pull on the back end of the hardware. To tighten the web, pull the free end.

Quickfit (adjustable) adapters, as found on chest and leg straps, may be easily loosened by pulling on the anvil of the hardware with the fingers, 90 degrees away from the sliding strap. This is easily accomplished even when the harness is on tightly, and the strap is under tension. Lifting the anvil

orients the hardware so that it will not grip the webbing; the strap slips out due to its own tension.



Correct threading of the friction adapter

Check all adjustable hardware for correct threading. Note that the anvil on the underside forces a bend in the web. Improperly threaded hardware will slip. All webbing ends must be spread and sewn, or rolled and sewn, so that they cannot slip out of the hardware.

The equipment check is that all-over gear inspection, sometimes referred to as a *pin check*, which we conduct on each other prior to boarding the jump aircraft. Initially, you will be checked by your jumpmaster. Later you will be checked by another jumper on your load, and you will check him or her. This final visual and physical pre-jump checkout is not to pass judgement on the design of the equipment; it is a double check to insure it was put it on correctly.

The following equipment check outline refers specifically to piggyback equipment with a back mounted reserve, but it is generally applicable to all parachuting gear. The check should be systematic to insure that nothing is overlooked. It should start in the front, run from top to bottom, and then continue in the back from helmet to boots. So let's get started.

The *helmet* should be snug so it can't slip down over the eyes, leaving the wearer *in the dark*. Grab the sides and try to rotate it. The strap must be secure, not just a snap-on type. Helmets lift off the head easily in terminal freefall, and this not only deprives the owner of its protection when he or she needs it, it presents a danger to spectators below.

Goggles or glasses must be secure and clean. Check for a retainer strap.

The *canopy releases* should be positioned down to the hollow of the shoulder, just below the collar bone. Put your hands on them and rotate them outwards so that you can check the mating and routing of the parts.

Ripcords properly stowed and routed.

Reserve static line (Stevens system). Make sure it is hooked up and routed properly.

Now moving down, check the *chest strap* for routing and hardware threading. If the chest strap has a snap, click it to make sure there isn't any cloth caught in it. Quick ejector snaps demand closer inspection; make sure they are fully seated by pushing the wing closed. Inspect the routing of the chest strap to make sure it is not around the main lift web or threaded through a ripcord handle. Is the *hook knife* accessible?

The pin check defined: A systematic inspection of another skydiver to ensure that all equipment is properly worn and routed. This inspection is not just for students, but for all jumpers on the load. - Don Towner

Instruments. Altimeter zeroed. Calibrate the automatic opener according to the owner's manual. Make sure the instruments do not block the view of the handles. Check the *radio* on students.

Make sure the canopy release *handle* is removable, but firmly in place. Periodically, the Velcro handle should be peeled away. The Velcro can become stuck shut if not peeled apart regularly.

See that the friction adapters on the *main lift webs* (if applicable) are threaded correctly and that the web ends are rolled back and sewn.

This throw-out pilot chute bridle is routed under the main lift web

Grasp the handle of the *throw-out pilot chute*, if there is one. Is it stowed properly in its pocket and is the bridle properly routed? Trace the bridle routing with your finger. Pay particular attention to where the bridle exits the pilot chute pouch. If the throw-out is on the belly band, is the belly band routed under anything, like the main lift web, and is it twisted? Is the belly band securely fastened?

There's more to check than pins. - J. Scott Hamilton

If there is a *chest reserve:* Ask if there is a pilot chute installed, feel for it and check for a *pilot chute removed* tag. The presence or absence of a pilot chute makes a difference in the selection of reserve procedure, and the wearer may have borrowed this chest pack. Kneel down and firmly grasp the reserve handle in the left hand twisting it gently in its pocket. This action will disclose a tight pocket and, of course, it will be impossible to grasp the handle if there is a pack opening band over it. With the right hand, open the pin protector flap. Pull the handle gently to just barely slide the pins, then grasp the last pin and pull to reseat them. Check the position of the instrument panel. Sometimes it is pushed too far forward, overlapping the pilot chute, and will prevent it from springing out. Make sure the side carrying handles are secured back under a pack opening band, so that one won't be grabbed in a hasty search for the ripcord handle. Is the belly band routed properly and secured to the main container? Now lift the reserve by pushing up from the bottom. Try to rock it upward; it should be tight.

Move on to the *leg straps,* checking friction adapter hardware for threading, and snaps for trapped fabric. Quick ejector snaps need a comfort pad between them and the jumpsuit. Loose straps should be stowed in the leg strap channel or retained by harness keepers, as a loose one may flutter in freefall, and this is very painful. Or the loose strap may get in the way of a throw-out pilot chute. Jumpers have been known to tug on loose leg straps when they thought they were extracting their pilot chute. On the ground, the problem is not so obvious because the straps hang down, out of the way. Make sure leg straps are not twisted. A twisted leg strap

with a throw-out pilot chute system will result in a horseshoe malfunction, the most dangerous kind. Make sure students do not cross the leg straps. This may sound funny, but more than one student has found it very painful.

Stand back and make an over-all visual inspection of the *front*. An unzipped leg pocket could put an inexperienced jumper into a turn. If there are lacing hooks on the boots, they must be taped over to prevent them from grabbing errant pilot chutes, suspension lines, or fabric.

Now, going around to the *back*, grab the housings and pull them sharply upwards. If they are not the expanding type, if the cable is long enough and if the housing is secure at both ends, the canopy won't dump out on the ground, or the canopy releases will not activate. Make sure the housings are routed under the riser and are tacked to the harness within 3" of their ends to avoid floating handles.

This main will probably activate the reserve when it deploys

No one ever died because of a pin check. - Paul Sitter

Make sure the main *risers* are routed over the reserve ripcord housing, are not twisted and the toggles are not showing.

Starting with the *reserve*: Open the ripcord pin protector flap. Make sure the pins or cables are properly seated. Check the grommets for excessive wear. Check the security of the seal to insure that no one has been inside except a rigger; and then look at the packing data card to make sure the reserve is in date. This is primarily to cover yourself in case the FAA shows up. Look at the hooks on the pack opening bands, if the container has them, to make sure they haven't worn holes in the container to grab something inside.

Now grasp the *cable* near the handle with the right hand, place your left hand on the cable near the loop to pull the cable back and forth in a sawing motion. This action will reveal kinks, as well as foreign matter, such as gravel inside the housing.

Look at the *friction adapters* on the backstraps (if they are exposed) and make sure they are properly threaded; check for webbing twists. Make sure the strap ends are stowed so they won't trail and snare a pilot chute.

Check the routing of the throw-out pilot chute *bridle*, or pull-out pilot chute handle, and the threading of the pin. Make sure the pull-out handle is firmly seated.

Inspect the *static line*, the snap and the webbing. Make sure the webbing is properly routed.

Now, a pat on the backpack will signify to the jumper that the check is complete. The whole operation probably took less than a minute.

Once everyone has been checked, equipment should not be removed or altered without a new check. Always perform a *pre-exit check* on your own gear just prior to jump run.

You will want to begin making equipment checks as early as possible in your jumping career, to help you learn about your own gear.

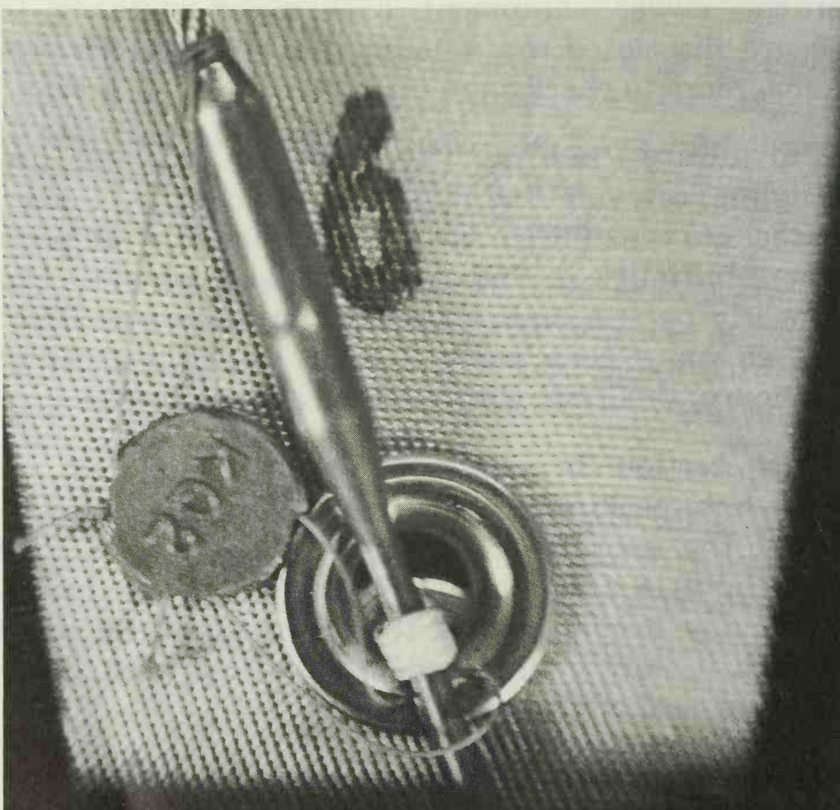
This pre-jump routine is often referred to as the *pin check* and this may have to be changed, as a lot of the newer equipment uses other methods to secure the closed containers. In any event, there is much more to check than pins.

Parachute Packing. The inspection, packing, untangling, carrying and minor maintenance of a sport parachute consumes a large percentage of a jumper's time. Initially, it will take an hour or more to properly pack a main parachute under supervision, but as you become more familiar with the packing sequence, this time will be cut to a few minutes.

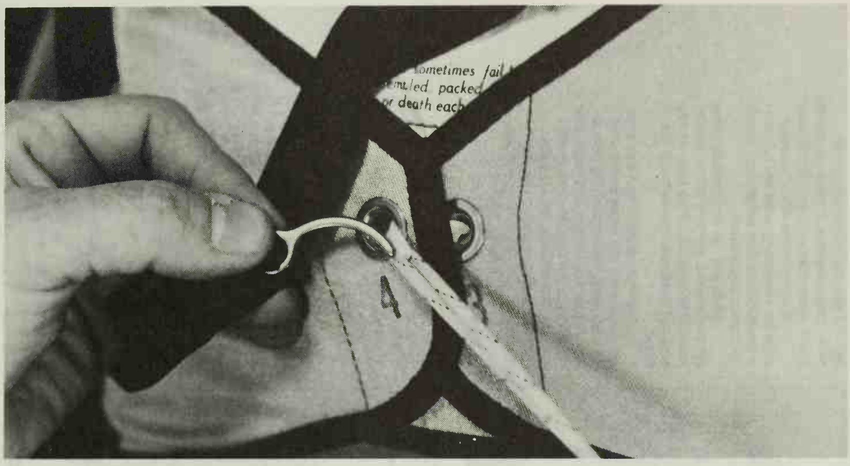
This section is designed to introduce you to parachute packing in order to help you better understand the operation of your own equipment. The parachute is a straight-forward mechanical device. Yet many people picture it as very mysterious, as though it were guaranteed to fail if not packed absolutely perfectly.

The main parachute may be packed by an FAA certificated parachute rigger or the user, while the reserve may only be packed by a rigger. The rigger

gives the reserve a thorough inspection, applies a lead seal to some safety tie thread, and then fills in and signs the packing data card. The FAA says you may not use a parachute that has not been packed within the last 120 days. You will pack your main parachute under supervision until signed off. Prerequisites for the signature are the capability to inspect and assess damage, being able to pack, being able to untangle the parachute, and the ability to conduct the pre-jump equipment inspection. All this will require a considerable knowledge of the parachute, and you will probably start your packing just after your first jump.



The parachute rigger seals the reserve after packing



Using the pull-up cord

Pull-up cord. About the only tool required for packing the sport main is a pull-up cord. The cord is used to pull a locking loop up through the grommets in the pack flaps, so that the locking pin can be inserted. Route the cord *under* the pin and pull the cord out slowly so you won't wear out the closure loop.

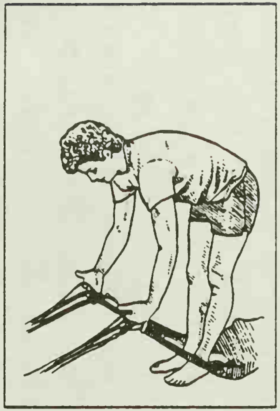
The packing procedure. Pack on a packing mat or dry lawn, out of the wind and out of the sun. Avoid asphalt and concrete as they will cause extra wear to the assembly. Inspect the parachute prior to packing. Carefully check the bridle attachment point, the canopy, the slider stops, the connector links, the slider bumpers on the Rapide links, the slider, the lines, the control line locking loops, the harness and containers.

The ram-air main canopy may be *stack packed* or *pro packed* (sometimes referred to as a *stand-up pack job*). These instructions from Precision Aerodynamics outline the pro packing method. Now, start by stowing your deployment brakes and then:

Main Canopy Folding Instructions

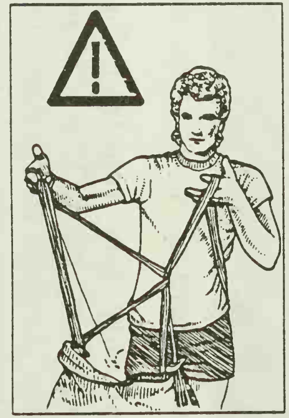
The Line Check

1. Crouch next to the risers and face your canopy. Slip the fingers of your left hand between each left-hand riser and between the left-hand steering line and the risers. Do the same with your right hand. The idea is to have each line group and each steering line occupying its own slot between two of your fingers.



2. Stand between the right- and left-hand riser groups and start moving up the lines, allowing them to slide between your fingers. Push the slider ahead, until you reach the bottom of the canopy.

At this point, it's possible to determine whether or not your canopy and lines are straight. If you have twists in the lines as shown, your rig has done a "loop" through your risers at some point. To fix this, drop the lines, stretch the canopy and lines out again and straighten out the entanglement. Get help from a rigger if you have any questions. Repeat the line check after clearing to confirm you have done it correctly.

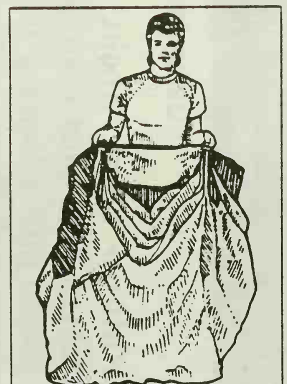


3. If you have something that looks like this, it's likely a control line is passed around everything else.

A control line which passes around everything else will result in a malfunction that will almost surely require a breakaway.

To fix this, lay the canopy down on the ground. Starting at the canopy, find the second and third lines on one end cell (these are called the B and C lines).

Carefully follow these two lines down through the slider to the links on the risers. You should be able to see where you will need to pass your rig through the lines to correct the steering line routing. Again, seek capable assistance if you have any questions.

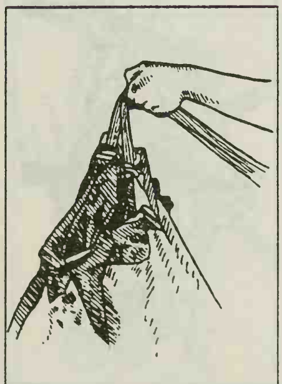


Flaking the Leading Edge

4. When you reach your canopy, pull both hands apart as far as the slider will allow. Shake the canopy a couple times to settle everything.

5. Now step to one side, outside the lines and transfer the lines in one hand to the other . . .

6. . . . so you are holding all the lines in one hand—preferably with your stronger arm.

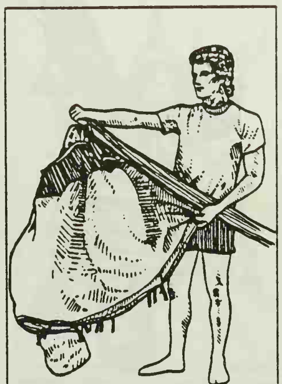


7. Locate the leading edge of the canopy; it should be facing your rig. (If it is facing "up" or away from your rig, it might mean your canopy has been attached backward.)

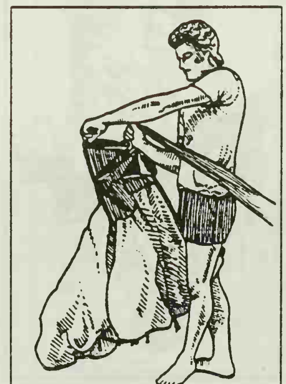
8. Starting with the end cell nearest your legs, flake the entire leading edge with one hand as shown.

9. Pull each cell all the way out and keep it in your hand. Then move to the next cell, taking care not to miss any, until all of them are in your hand.

10. When you've got the entire leading edge flaked . . .



11. . . . tuck it between your knees and hold it there.

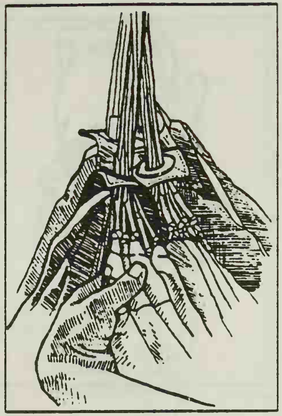


Clearing the Stabilizers.

12. Since all the lines are bunched up in the middle, pull out each stabilizer panel one by one until they form an irregular shape resembling the petals of a flower viewed from the top.

13. Find the group of A lines on one side of the canopy. With the canopy held in front of you as you have it now, the A lines are the front part of the line group that go through the front slider grommets, the ones that should be closest to you.

(Each load-bearing cell rib has four lines attached to it: the A line at the leading edge, followed by the B and then the C lines, ending with the D line closest to (but not on) the trailing edge. Some cells have control lines attached to them at the trailing edge. The A and B lines pass through the front grommets of the slider, while the C, D and control lines all pass through the rear grommets.)



14. Since there is a lot of fabric between the A and B line attachment points, it's easy to separate the two line groups; (See the drawing.)

Now you're going to S fold the rest of the canopy like the stabilizers. Put your hand in between the A and B lines on one side (near where they pass their own grommet) and pull them out to one side. This will give the cells on one side the correct type of flaking. Now repeat with the other A and B group, pulling the fold out the other side.

15. Now that you've pulled out the canopy between the A and B line groups, do the same thing between the B and C lines: pull the fold between the two groups out to each side. When you look down between the stabilizer folds after you've done your "flaking," the folds should look nice and neat like this.

Flaking the Trailing Edge

16. Now find the D line group, the group of lines nearest the tail. (Not the control lines; they are attached at the trailing edge.)

17. Take the whole D line group on one side . . .

18. . . . pull it out gently; then fold it with one motion to put a real fold in the fabric between the C and D lines. Do the same thing on the other side.

19. Now grasp the control lines where they attach to the trailing edge, pull the entire trailing edge out and drop it straight down.

20. Flake the trailing edge neatly on each side as shown. The center portion of the trailing edge--the section between the left-hand and right-hand control lines--can't be flaked and will hang down. You'll straighten this out next.

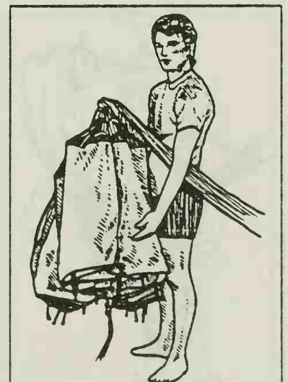
21. Reach down and pick up the very middle point of the trailing edge (the ID panel is sewn to the top of the center cell near the trailing edge.) Lift it up and put the very middle seam up with the slider grommets, holding it in place with your thumb or finger.

If your canopy is new, or if it tends to open uncomfortably fast, then follow steps 22 through 25. Otherwise, skip to 26.

Optional (For Slower Openings)

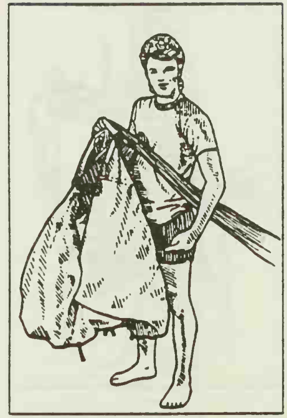
22. Loosen your knee grip on the leading edge of the canopy. Find the very middle of it. (It's easy. Just run your hand down between the front two slider grommets; exactly half the lines will be on one side and half on the other.)

23. While leaving the very middle cell hanging, pick up all the others on one side and roll them in toward the middle.



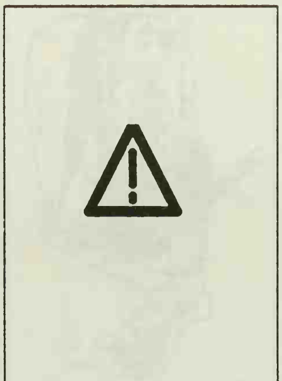
24. Do the same on the other side. When you're done, this is how the leading edge should look.

25. This shows how steps 23 and 24 help slow down openings. As the canopy opens (remember, this illustration shows the canopy upside down), the center cell inflates and the sides are slowed somewhat by the fact that they are rolled separately. The result is more controlled, symetrical inflation.



26. You have in your hand a neatly flaked canopy. The leading edge is brushing up against your legs and the middle of the trailing edge is still being held along with all the lines.

If you want your canopy to open faster, just leave the leading edge hanging neatly flaked; don't roll it at all. (Skip steps 22 through 25.) This leaves the leading edge exposed to the airstream and will help the canopy inflate faster.

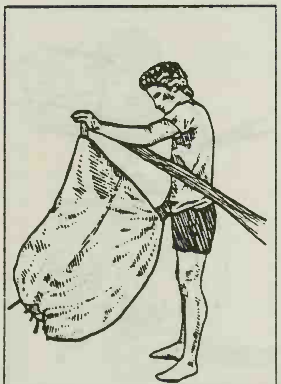


27. On one side, start at the middle of the trailing edge being held under your thumb and pull the excess material straight out. You're pulling out the trailing edge of the canopy that extends from the inside control line to the very center of the trailing edge.

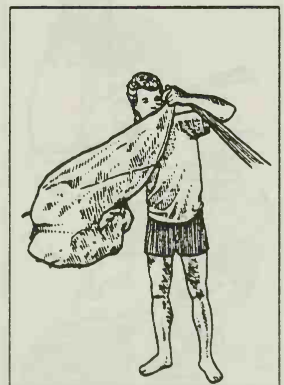
28. Holding the lines firmly with the other hand, wrap that part of the trailing edge halfway around the canopy. Hold it in place with your knees. Fold the trailing edge on the other side of the canopy in the same way.

BE CAREFUL WHEN PULLING THE TRAILING EDGE AROUND THE BUNDLE. BE SURE TO LEAVE THE CONTROL LINES UNDISTURBED. IF YOU WRAP THE CONTROL LINES AROUND THE BUNDLE ALONG WITH THE TRAILING EDGE, YOU MAY INDUCE A LINEOVER MALFUNCTION.

29. Take both trailing edge pieces in one hand and . . .

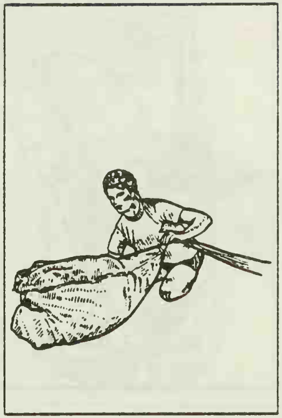


30. . . . roll them together in to the middle so they completely encase the rest of the canopy.

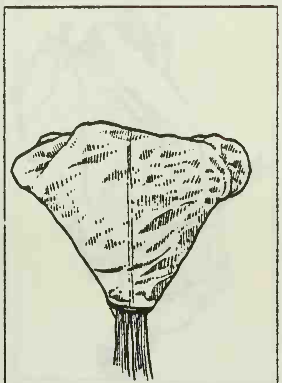


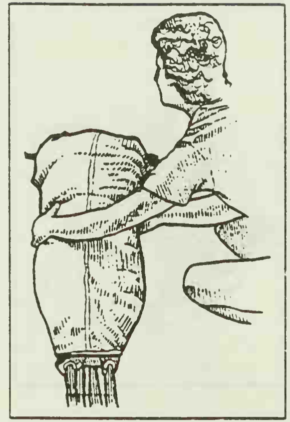
31. Place your free hand carefully under the bundle.

32. Swing it out slightly so that lines stay taut and gently lay it on the floor.



33. As it rests on the floor, the canopy should be triangular in shape as shown.





34. Tuck the sides under, starting at the slider and working up, making the canopy into a flattened cylinder shape.

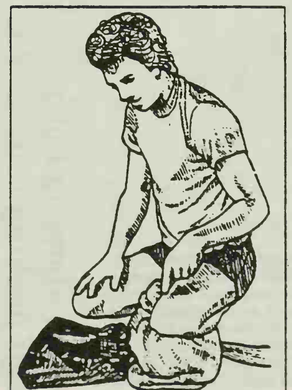
35. Move to the side of the canopy and put one hand under the slider edge of the bundle. Place the other hand on top a little farther up.

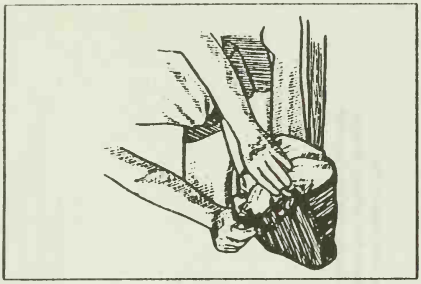
36. Make a small S fold as shown.

37. Now put one hand under the top of the bundle and make an S fold in the opposite direction, as shown.

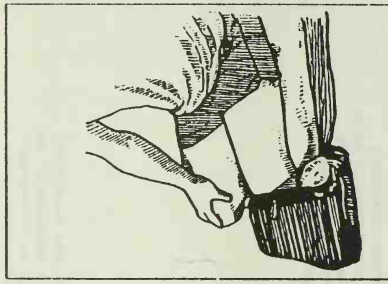
38. You should now have a neat, compact bundle. Try to make the folds so that the bundle ends up being just a little wider than the deployment bag.

39. Place your knee in the middle of the canopy to keep it together while you pull the bag over it.





40. With your knee still in place, pull the bag over the canopy one side at a time. Hold the corner of the canopy bundle up while you pull the bag over it; then roll the canopy into the corner of the bag. This helps get the canopy firmly into the corners, making a neater pack job.



41. The whole canopy should be in the bag before you remove your knee.
Follow your harness/container manufacturer's instructions for closing the bag, stowing the lines, placing it in the pack tray and closing the container.
It takes practice to pack both quickly and neatly. Every jumper has their own "system" to make the job easier, and you'll quickly develop one of your own.

The above is not meant to be a complete do-it-yourself packing course. You will be closely supervised as you learn, and you should always ask about a procedure if you are not absolutely sure. But these instructions will serve as an introduction to packing and will help you to better understand the operation of your gear.

Parachute care. Protect your parachute by avoiding abrasion (do not drag it on the ground), fluids (no water jumps) and sunlight (do not pack in the open). The ultra-violet rays of the sun will deteriorate your canopy very rapidly. If you take 15 minutes to pack outdoors, then after 280 jumps, your canopy has been in the sun the equivalent of a week of ten hour days, and that is enough to lower the strength by 50%. Nylon never recovers; it just gets weaker and weaker. The above week in the sun does not even count the two to four minutes of exposure on each jump. So pick up your canopy after landing and carry it to a clean, shaded packing area.

High heat is also bad for nylon, so do not leave your parachute in the trunk of your car on a hot day. Do not wash your canopy and do not jump in the rain. Any water will make the fabric more porous. For details on what affects nylon, see Chapter Nine of *The Parachute Manual* by Dan Poynter.

Parachute repairs and alterations. Inspect your gear frequently for damage and wear. Repairs to a *reserve* assembly must be performed by an FAA certificated parachute rigger. Most repairs to a *main* parachute assembly must be done by a rigger, but there are a few you may perform if you have adequate knowledge and skill. You are certainly authorized to inspect your gear, and this chapter has described a number of things to look for. Major repairs and alterations to parachutes may only be performed by a master rigger, while minor repairs and maintenance may be performed by a senior or master rigger.

Try some silicone spray on your main canopy. Spraying the lines will help prevent slider hang-ups and abraded lines. Sprayed on rubber bands, the bands become soft, flexible and stretch better. Sprayed on risers that brush past Velcro hook, the webs avoid getting the *fuzzies*. Silicone will slick-up the 3-Ring release cables for easy, wear-free pulls. The silicone sold in SCUBA shops is a food-service grade, pure silicone that does not contain petroleum distillates.

Frayed and broken rubber bands should be replaced.

Small tears and holes in the main canopy may be repaired with ripstop tape. Check with your rigger.

Buying a parachute used to be easier and a lot less expensive. Of course you got what you paid for, too. In the old days, up to the mid-seventies, most parts were pretty-much interchangeable. Most canopies would fit most containers, and most harnesses could be adjusted to fit all. Today there are so many canopy and container sizes, that both must be measured and stamped with their volume in cubic inches to insure compatibility. Since it is nearly impossible to purchase a used part here, and a used component there, to assemble the right rig for you, you might as well buy new ones. If you buy new equipment, you will not only get a harness that fits, the canopies will be sized for your weight and will be designed for your kind of jumping, while you will get your choice of colors.

Just as there are many types of parachuting, there are many types of specialized main canopies. If you like competition accuracy, you will want a relatively large canopy that will sink well and remain stable in deep brakes. If you are planning to do primarily canopy relative work, you will want a canopy without cascaded (joined) front-center lines. CRW jumpers wrap their legs around these lines and they can become caught in the confluence of cascaded lines. If your main interest is relative work, you will choose a low-weight, low-volume canopy with a good glide to make up for bad spots. Ask your instructor, ask skydivers who do the type of jumping you like, and check the canopy sizing discussion in this chapter to make sure the canopy you buy is not too large or too small.

Be very wary of main canopies with more than 300 jumps on them. New fabric has a permeability of

one to three cubic feet of air per minute (CFM). After a few jumps, the thin fabric begins to open up, and it becomes more porous with each jump. When the permeability reaches eight CFM, some performance is lost. When it reaches 13 CFM, the canopy will descend faster and may snivel on opening. Any canopy with 300 or more jumps is fairly porous, has been exposed to the sun and may even have been used for a water jump. The effective life of a canopy is perhaps 500 jumps. Some parachute shops are offering fabric porosity testing. Invest in their service before you buy a canopy.

Since the buying (skydiving) public wants their parachutes to be low-weight and low-volume, the manufacturers are using lighter materials. The trade-off is that the gear does not last as long as it used to. The service life of today's parachutes is not short, but it is shorter than it used to be. Now, manufacturers are even considering stamping their gear with a service life date. They explain their actions are not planned obsolescence, but a way to warn the owner to have the older gear checked by the factory or a rigger.

If you do decide to buy used equipment, have the gear checked out by a rigger. Get an estimate to replace worn Velcro and make all the other minor repairs.

Buying used equipment piecemeal—a container from one person, reserve canopy from another and a main from a third source—often creates problems getting the parts to fit together properly, because of the melange of sizes and shapes out there. Even an experienced jumper who knows what is available, and is looking for used gear, would do well to buy complete rigs that were ordered originally as a matching unit. - Bill Dause

Do not buy a reserve canopy that has been deployed. Reserves must be at 100% factory strength. Even a single use may damage the canopy, and the damage may not be visible. Check the packing data card against the data panel on the canopy and make sure you have all the cards. Any deployment should be noted on the card. Do not buy a round canopy with mesh vents, unless they have been checked by a rigger. Some mesh has a high acid content that damages adjacent nylon panels over time.

> *Don't be tempted to save weight and bulk by buying a reserve which is too small for you.* - Gary Thompson

Chapter Eight

Specialized Jumps

To most people a parachute jump is a parachute jump, and it is pretty scary at that. To a seasoned skydiver, there are as many types of jumps as there are ignorant people. You can make low ones or high ones, on land or in the water, at noon or after dark, carrying smoke on a demo or a camera to shoot your friends, singly or with a team, out of a plane or a balloon, practicing for the Competition Style event or. . . the list is endless. And, while this book deals with the parachute principally as a means of recreation, no book would be complete without a mention of the many other uses. The military airborne troops and the fire-fighting smoke jumpers use the parachute for quick vertical transportation; military aviators use the parachute as survival equipment and, of course, it is used to drop equipment, to slow race cars, etc. In the next

few pages, we will examine some of these other uses of the parachute.

A *hop n' pop* after dark

Night jumps are not only fun to make, they often turn an otherwise dull evening into a great parachuting social occasion. After jumping, it is time to party. Night jumps are more than just an extension of daylight jumping, because of the added preparation which is required. One must have lighted instruments, a flashlight to check the canopy after opening, a flashing red warning light, lighted target, lighted wind drift indicator, additional ground crew, etc. So it is no wonder that night jumps are made less than regularly. Since two 20 second night jumps (one solo and one RW) are required for the USPA D license, most drop zones schedule them two or three times a year. You will not be eligible to make a night jump until you have your USPA C license, but you may attend the ground training any time. For further details on night jumping, consult USPA's *Skydiver's Information Manual*.

Water jumps are a great combination of aviation and water sports, something you will want to do at least once every summer. While unintentional water landings have taken a number of lives, preplanned water jumps have a good record.

Both planned and unplanned, water jumps terminate in the water. But just like the survival score card for each of them, the approach to them is different. See the discussion in Chapter Four.

Do not wear a jumpsuit for water jumps

When you plan to go into the water, you need less protective clothing, and want to avoid a soggy jumpsuit that will make swimming difficult. So chute up in a helmet, T-shirt, swim suit, running shoes (you might miss the lake) and a life vest. Freefall without your familiar jumpsuit will be interesting; there is very little air drag on the extremities and you will probably flail all about trying to grab some air.

Do not subject your good ram-air main canopy to a water jump. The water will increase the permeability of the fabric. Water jumps are a good time to try a round canopy.

After the jump, you will have some equipment to clean and dry. If you went into clean, fresh water, the main parachute may be suspended in the shade to drip and dry. The reserve should be taken to a parachute loft for repacking, and it is best to leave it in its protective container rather than risk snagging the canopy. If the water was salty, it should be hosed off the suspended canopy. Neither fresh nor salt water will injure nylon, but they will damage cotton, so dry out any cotton parts right away. Pay special attention to the hardware; dry it so it won't rust.

Dry training for unintentional water jumps is required for your USPA A license. Wet training (with all your gear in a pool) is required for your USPA B license. You must have at least a USPA A license to make an intentional water jump and you may attend wet training at any time, so ask your instructor for a schedule. See USPA's *Skydiver's Information Manual* for more information.

Landing in snow is great fun, especially when it's soft and powdery

The chamber ride teaches each jumper to recognize his or her own symptoms of oxygen starvation

High altitude jumps. Most sport jumps are initiated from relatively low altitudes for a number of reasons. Except for the largest team maneuvers, virtually all types of jumping can be adequately performed on a 30 second delay, so 7,200' has become a common exit altitude. The air becomes thinner as you climb higher, and airplanes don't run as efficiently, so they become more expensive to operate. And in the thinner and thinner air, the body falls faster. So you reach a point where a little more altitude just isn't worth the extra effort or expense.

Most small jump airplanes can't get enough oxygen for their engines when hauling a full load of jumpers above 13,000', and most jumpers begin to notice the effects of oxygen starvation on themselves at about this level. The lack of oxygen (*hypoxia*) affects each person in a different way, but it usually begins with a light-headed feeling. Without sufficient oxygen, the brain doesn't operate too well; spotting and other skydiving chores become less accurate.

It is possible to go much higher; we do it all the time, but extra equipment is required. Commercial airliners regularly fly at 25,000' to 40,000' with pressurized cabins. If you go above 8,000' for more than 30 minutes, you should have supplemental oxygen aboard the aircraft. In fact, with oxygen, you can go all the way up to 40,000' before a pressure suit or pressurized cabin becomes necessary. With pressure suits, parachutists have ascended in gas balloons to more than 100,000'.

The temperature steadily decreases at the rate of 3.7 degrees Fahrenheit per thousand feet with altitude; just keeping warm can be a big problem. The

temperature could be 70 degrees on the ground and minus 42 degrees at 30,000 feet.

Physiological flight training is available at several Air Force bases around the U.S. by applying through the USPA, and many sport parachutists take advantage of the two-day course, even if they aren't planning to make a high one. The classroom session is followed by a *chamber ride*; the class enters a large room-size capsule and the air is pumped out to simulate altitude ascension. As they go *higher and higher*, each person has the opportunity to observe his or her own individual reactions to the ever decreasing level of oxygen. Then they learn that, when they put on their oxygen masks, it takes only a couple of deep breaths to clear the head and bring them back to normal.

For more information on high altitude jumps, see USPA's *Skydiver's Information Manual*.

Camera jumps. The reason that the aerial photographs in this book are so clear is that they were taken by jumping photographers, air-to-air; the photographers were up close to the action. Whuffos, with no understanding of freefall parachuting, often think the photographs were taken from an aircraft (*in a 110 mph. dive?*).

If you would like to get into air-to-air photography, you must be good at both parts: photography and relative work. The first choice you will face will be between still or motion cameras. and most select stills because they are cheaper to operate. Most freefall photographers use motor-driven 35mm cameras, with about a 35mm angle lens and a 1/250 second, or faster, shutter speed. Those shooting

movies often use a 16mm N-9 gun camera with a wide angle lens. Both are electrically operated, usually with a hand switch.

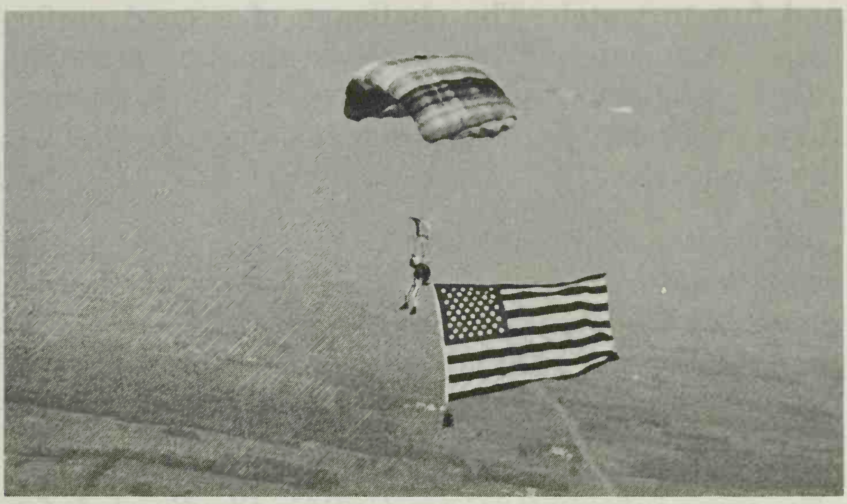
Motorized cameras are helmet mounted; the photographer flies in the middle of all the action.

Many freefall photographers shoot video, and more and more are starting with it. Video provides instant feedback on your technique, and it is less expensive than film. Video photographers usually use small camcorders with a wider angle lens.

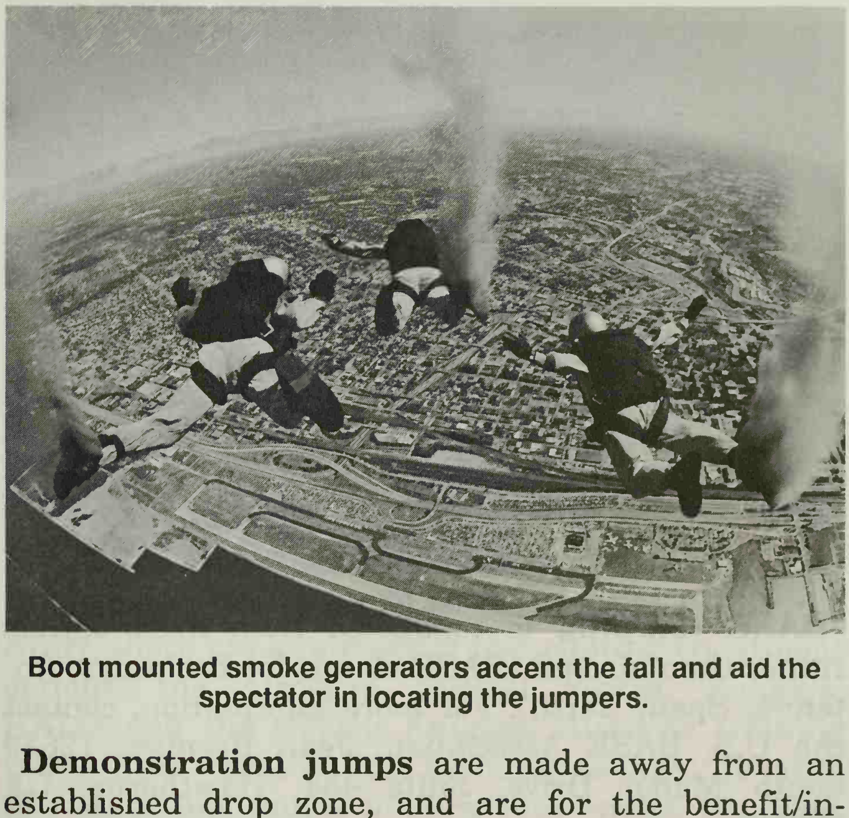
The best photos are taken on bright days, or when there are just a few white cumulus clouds in the background, either early or late in the day when the sun is low.

It is difficult to monitor the altitude when shooting pictures, so you must be sure to choose reliable subjects who will give you a clear signal at pull time. As a back-up, wear an audible altimeter. Also, be careful not to deploy your pilot chute into your helmet-mounted camera.

A sure way to win friends in parachuting is to buy a camera; the sky above is full of camera hogs.



Demo jumps are great crowd pleasers



Boot mounted smoke generators accent the fall and aid the spectator in locating the jumpers.

Demonstration jumps are made away from an established drop zone, and are for the benefit/instruction of the spectators. They are fun to make

and fun to watch. The challenge of a good performance into a tight DZ is one that most parachutists will eagerly seek. And, of course, one must be careful to do an especially good job; it's bad press to miss the target.

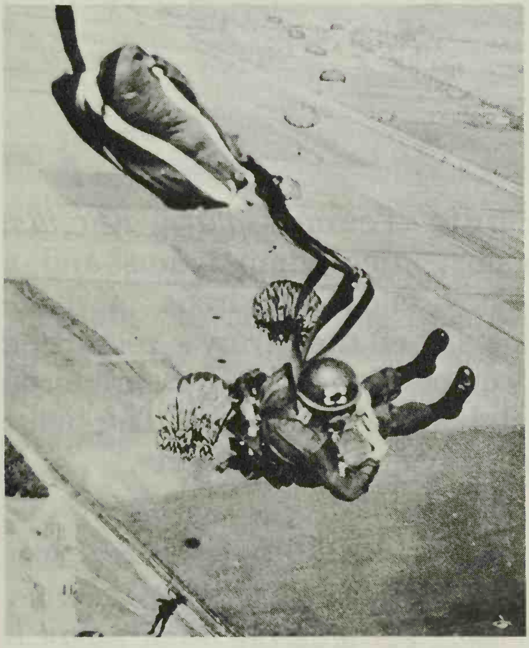
A good demonstration jump requires a great deal of prior planning, from lining up the aircraft with proper radios and pilot, to clearing the jump with the FAA, state and local officials. It is a lot of work to make all the arrangements and get all the required paperwork.

For more information, see USPA's *Skydiver's Information Manual*.

Owen Quinn dives off the World Trade Center

BASE jumping is conducted from fixed objects rather than aircraft (BASE stands for Buildings, Antenna, Span, Earth). For more information, contact the U.S. BASE Association, Jean Boenish, 12619 South Manor Drive, Suite 454, Hawthorne, CA 90250.

Tim Domenico dives off El Capitan in Yosemite

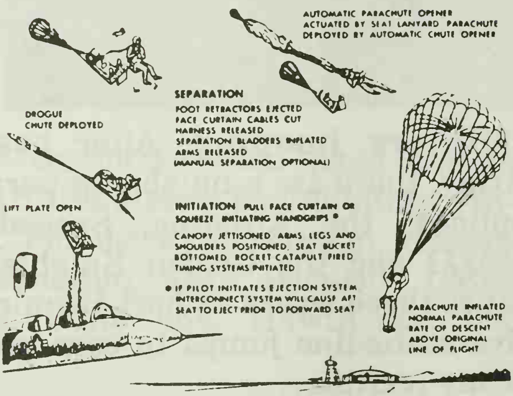


An airborne jump

Military jumping. After basic training in the Army, there are a number of parachuting enlistment options: the Airborne, Special Forces, Rangers, HALO and the Golden Knights. Airborne training takes three weeks at Fort Benning, Georgia. It takes five static-line jumps to earn your wings. See your Army recruiter.

HALO (High Altitude, Low Opening) troops are trained to infiltrate hostile territory by flying in very high, out of ear shot, and freefalling down to silently open and glide in for a grouped landing behind enemy lines.

The Army Parachute Team, *Golden Knights*, consists of two demonstration jump teams and a competition team. They make hundreds of demo jumps each year as part of the Army's recruiting program, while the competition team has produced numerous national and world champions. The home of the USAPT is Fort Bragg, North Carolina.



Ejection seat sequence

At the Air Force Academy in Colorado, students not only receive a free education, they may learn parachuting for credits.

The Smoke Jumpers, the parachuting firefighters, have become an effective weapon in the constant battle against forest fires.

The parachute was first used to fight fires in 1925, when equipment and supplies were dropped to firefighters on the ground. Time is of the essence when a fire begins, and it was later realized that the fastest means of transportation to otherwise inaccessible areas would be via aircraft and parachutes. The time saved in reaching a fire would be measured in days; the amount it cost to fight the fire, reduced by thousands of dollars; and the amount of land and timber saved, in the millions of dollars.

The Forest Service operates a school in Missoula, Montana, to serve the 12 smoke jumper bases in Alaska and the lower 48. Some 400 applications are received each year for perhaps 20 openings, and training is so tough that about half the students wash out. Would-be applicants should be aware that the Forest Service is more interested in candidates with prior fire fighting experience than in seasoned parachutists. In fact, smoke jumping is so different, a sport parachutist finds that many freefall habits have to be broken during training. The Smoke Jumpers, like the Airborne, use the parachute only as quick, efficient vertical transportation. There are about 385 Smoke Jumpers in the U.S., who average 13 to 25 jumps each fire season into rough terrain. For more information, write Smoke Jumpers, U.S.

Department of Agriculture, Forest Service, Missoula, MT 59801.

Vertical wind tunnels permit skydiving without constant repacking. For more information, contact Flyaway Indoor Skydiving, 519-P North Parkway, Pigeon Forge, TN 37863.

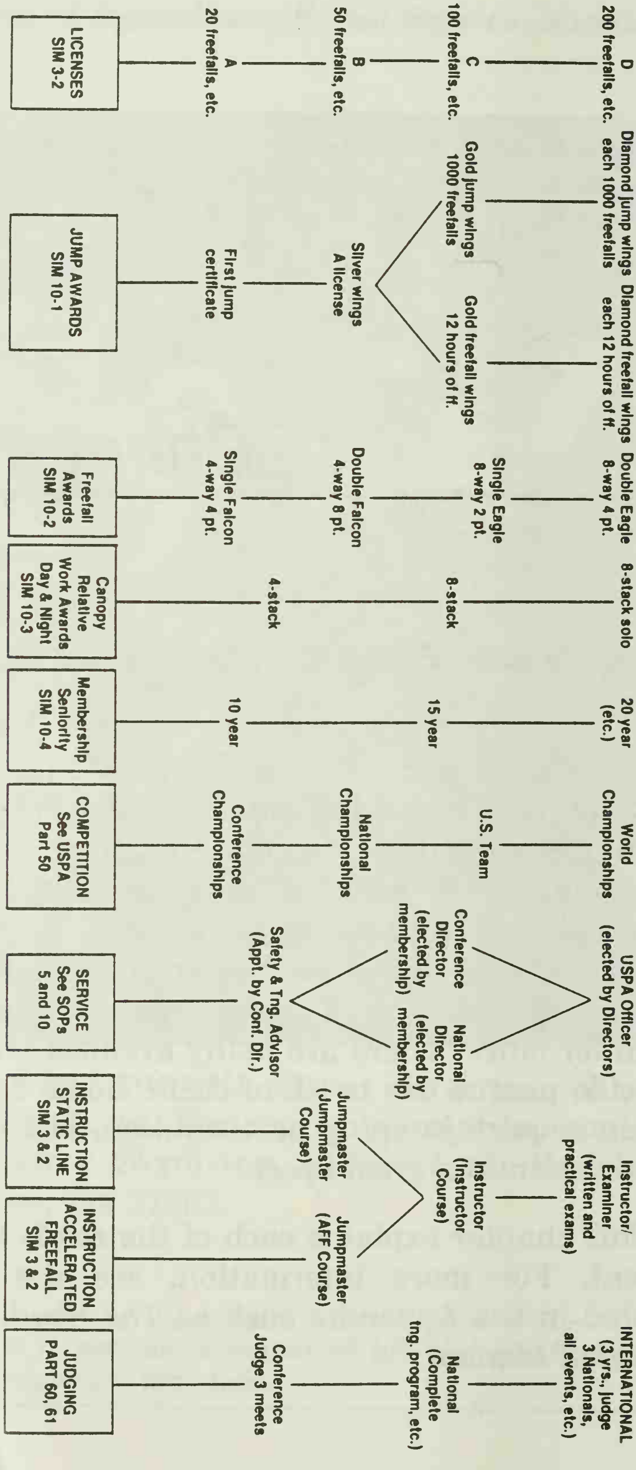
Skydiving: It is not just a matter of life and death... it is much more important than that.

Chapter Nine

Advancement in Parachuting

Now that you have made your first jump and admit to being hooked, it is time to plan where you are going. Many roads to sport parachuting advancement are open to you. You may qualify for awards for a number of jumps, time in freefall and various types of jumps. You may enter competition as a contestant or judge, become an instructor or run for office. There are many avenues and you may decide pursue one or all of them. Some roads do not even require jumping participation, but all demand dedication to a great sport.

This chapter explains each of the roads to advancement. For more information, see the references listed in the Appendix such as *The Skydiver's Information Manual.*



Many roads to advancement are open to the skydiver;
you may elect to pursue one or all.

Licenses. The USPA issues four classes of parachuting licenses recognized by all member nations of the Federation Aeronautique Internationale. With a license, you may travel and jump almost anywhere in the world. See *The Skydiver's Information Manual*. The requirements for each class of license follow.

3-1.04 USPA A License—Basic (20)

Persons holding a USPA A License are able to jumpmaster themselves, pack their own main parachute, perform basic relative work and water jumps, and have:

A. Completed 20 freefall jumps, including:

1. at least 3 controlled freefalls of 40 seconds or longer;
2. accumulating 5 minutes of controlled freefall time.

B. Landed within 20 meters of target center on 5 freefall jumps, during which they selected the exit and opening points.

C. Demonstrated ability to hold heading during freefall and make 360 degree flat turns to both the right and left.

D. Demonstrated the ability to safely jumpmaster themselves, to include independently selecting the proper altitude, exit and opening points.

E. Demonstrated ability to properly pack their own main parachute and conduct safety checks on their own, and other skydivers' equipment.

F. Documentation of unintentional water landing training from a USPA Instructor.

G. Demonstrated the ability to safely engage in relative work by:

1. performing satisfactory door exits;
2. varying both rate of descent and horizontal movement;
3. participating in at least three 2-way RW jumps;
4. Moving horizontally away from other skydivers in freefall; checking the air so the parachute may be deployed without creating a danger of collision with other jumpers; and keeping track of other canopies in order to avoid collision.

H. Passed a written examination administered by a USPA Instructor or S&TA.

License Fee: $20.00

3-1.05 USPA B License—Intermediate (50)

Persons holding a USPA B License are able to jumpmaster themselves, pack their own main parachute, perform water, night and relative work jumps, participate in record attempts and have:

A. Met all current requirements for, or hold, the USPA A license.

B. Completed 50 freefall jumps including:

1. at least 3 controlled freefalls of 45 seconds or longer;
2. accumulating at least 10 minutes of controlled freefall time.

C. Landed within 10 meters of target center on 10 jumps.

D. Demonstrated the ability to perform individual maneuvers (a figure 8, backloop, figure 8, backloop) in freefall in 18 seconds or less.

E. Documentation of live water landing training, with full equipment; in accordance with procedures in section 9-2 (August 1987) of the *Skydiver's Information Manual.*

F. Passed a written examination conducted by a USPA Instructor or S&TA.

License Fee: $20.00

3-1.06 USPA C License—Advanced (100)

Persons holding a USPA C License are able to jumpmaster other licensed skydivers, pack their own main parachute, participate in certain USPA competitions and record attempts, perform relative work, night, water and demonstration jumps, are eligible for the USPA Jumpmaster rating and have:

A. Met all current requirements for, or hold, the USPA B License.

B. Completed 100 freefall jumps including:

1. at least 10 controlled freefalls of 45 seconds or longer;
2. accumulating at least 20 minutes of controlled freefall time.

C. Landed within 5 meters of target center on 20 jumps.

D. Completed at least 4 points on a 4-way or larger random skydive (meeting the requirements for the Falcon Award).

E. Passed a written examination conducted by a USPA Instructor or S&TA.

License Fee: $20.00

3-1.07 USPA D License—Master (200)

Persons holding a USPA D License are able to jumpmaster other licensed skydivers, pack their own main parachute, par-

ticipate in all USPA competitions and record attempts, perform relative work, night, water and demonstration jumps, are eligible for all USPA ratings and for appointment as a Safety and Training Advisor and have:

A. Met all current requirements for, or hold, the USPA C License.

B. Completed 200 freefall jumps including:

1. at least 10 controlled freefalls of 60 seconds or longer;
2. accumulating at least 1 hour of controlled freefall time.

C. Landed within 2 meters of target center on 25 jumps.

D. Demonstrated the ability to perform individual maneuvers (in sequence—Back Loop, Front Loop, Left Turn, Right Turn, Right Barrel Roll, and Left Barrel Roll) in freefall in 18 seconds or less; **or** completed at lease 2 points on an 8-way or larger random skydive (meeting the requirements for the Eagle Award).

E. Made two night jumps (one solo and one RW) with a delay of at least 20 seconds, with verification of prior night jump training from a USPA Instructor. The night jumps must be made with the advice of an S&TA in accordance with USPA BSRs.

F. Passed a written examination conducted by a USPA Instructor or S&TA.

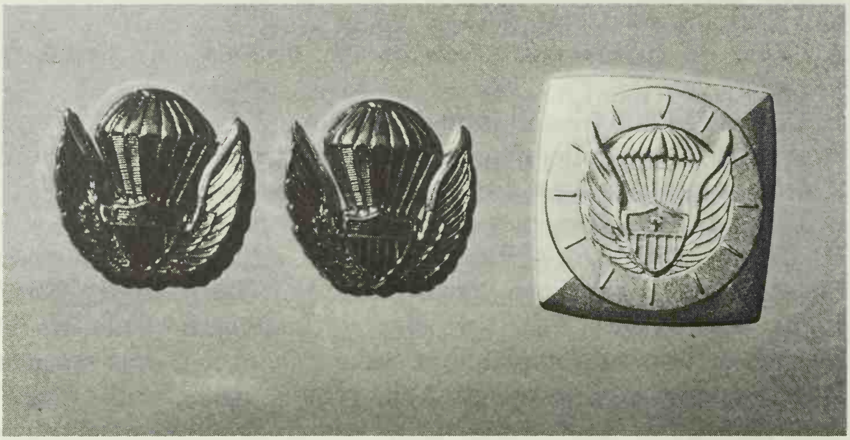
License Fee: $20.00

Restricted licenses may be issued under extreme circumstances to applicants who are unable to perform certain requirements, due to a physical handicap. Restricted licenses are indicated with a "R" following the license number. An example would be *D-454R.*

Awards. A number of achievements in sport parachuting are recognized by the USPA through a system of awards. See *The Skydiver's Information Manual.*

—First Jump Certificate—Authorized by USPA to be presented by instructors and instructor/examiners to those persons making their first sport

parachute jump under the provisions of the Basic Safety Requirements.



Jump awards

—**Parachutist Badge**—Created by the USPA in 1962, a design symbolic of a national aero sport with the wings of flight, the U.S. national shield, and the open parachute. Issued to all license holders.

—**Gold Expert Parachutist Badge**—Awarded to those USPA members holding the USPA D license who have made 1,000 freefall parachute jumps, under the provisions of the Basic Safety Requirements. Gold Wings with diamonds are awarded to those accumulating up to 10,000 jumps, and Gold Wings with rubies are awarded to those making up to 20,000 jumps. The jumps must be verified by a Conference or National Director, or by USPA Headquarters.

—**Gold Freefall Badge**—Awarded to those USPA members holding the USPA D license who have recorded 12 hours of freefall time, all jumps being made under the provisions of the Basic Safety Regulations. Badges have diamonds for each addi-

tional 12 hours through 120 hours and then rubies are added. The time must be verified by a Conference or National Director, or by USPA Headquarters.

—**Membership Seniority Certificates** are issued in five year increments to those with ten or more years of accumulated USPA membership.

Freefall awards

—**Sequential Relative Work Awards.** *Falcon* and *Double Falcon Awards* are available to individual relative workers who have performed the required number of sequential formations on a 4-way or larger jump. *Eagle* and *Double Eagle Awards* recognize sequential formations on 8-way or larger skydives.

—**Canopy Relative Work Awards.** The *Four Stack Award* is available to those who have successfully participated in canopy formations of four or larger. The *CCR* is awarded to a Canopy Crest Recipient for participating in canopy formations of eight or larger. The *CCS* is awarded to those who have entered eighth or later, on a formation of eight

or larger. Night versions of the CRW awards are also available.

CRW awards

Competition is an important part of sport parachuting. In fact, some say that you must have competition to just call it a *sport*. While there are those who enjoy non-evaluated jumping, most skydivers get into competition sooner or later, at least at the local level. Many clubs run student events, with slightly modified rules, so you will probably be making competitive jumps very soon. See USPA Part 50.

The *classical*, some say *old*, events are accuracy and style. Newer team events are 4-way, 8-way and 10-way relative work, canopy relative events and others.

The 5 cm. disc is often part of an electronic scoring pad

—**Accuracy** is the earliest and simplest of the parachuting events. You exit the aircraft at 750 meters (2500'), open, and steer to land as close as possible to a 5 cm. (less than two inches) disc. In national competition, most landings are so close, the judges don't even bother to measure beyond five meters. In student competition, accuracy is sometimes modified into a *hit and run* event, where the competitor lands as close as possible and then is timed until he or she steps on the target. See USPA Part 51.

Happiness is successfully cutting away a malfunction onto a steerable reserve, at a meet, and coming in for a dead center, standing up; and refusing the rejump. - Mr. Smith

Turning good Style requires a tight body position

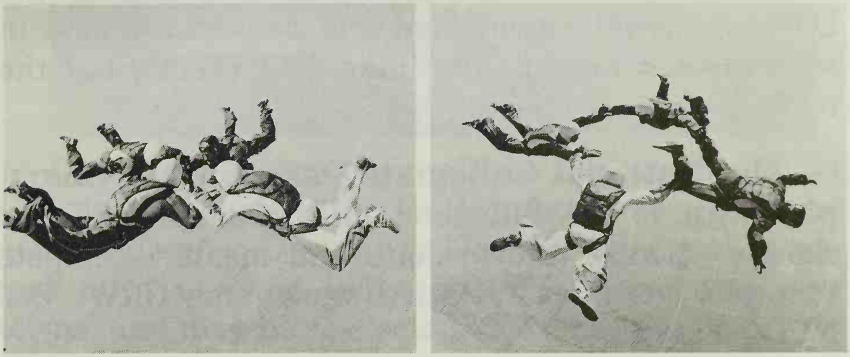
—**The Style** competitor exits the aircraft at 2000 meters (6600'), falls in a tight position for about 15 seconds to build up speed, and then whips into a series of maneuvers for time. All three groups are: *turn, turn, back loop, turn, turn, back loop* but there are three combinations. One is right turn, left turn, back loop, right turn, left turn, back loop. Years ago, a time of 15 seconds was good, but now you aren't competitive unless you are under eight seconds. And the turns and loops must be good; the judges dock points for undershoots, overshoots and other types of sloppiness. See USPA Part 51.

—**The Para-Ski Championships** combines accuracy jumping and giant slalom skiing. This event is popular in both the U.S. and Europe. See USPA Part 52.

One nice thing about our sport of parachuting is that the competitors make the rules. - Elif Ness

—Team Freefall Events.

The *Four-Way event* begins at 2900 m (9500') and consists of a series of pre-selected random freefall formations. If the team completes the sequence within the 35 seconds working time, it begins to repeat the maneuvers.



The Four-Way event

Eight-Way sequential requires the team to exit at 3600 m (12,000') and perform a series of maneuvers, one after the other. Since some of the formations are drawn at random, it is impossible to practice for specific competition. Instead, the teams must do a lot of hot diving and flying to learn to work together and fly well. See USPA Part 55.

The Ten-Way speed star was the earliest form of team competition and it drew so much interest that it changed the sport and the competition. In Ten-Way, the team exits the aircraft at 2300m (7500') and puts a 10-way star together as fast as possible. In the early days, it was an accomplishment to form a trickily balanced star. Now they are being formed regularly in less than four seconds.

—**Canopy Relative Work** events are Four-Way Rotation, Four-Way Sequential and Eight-Way Speed. See USPA Part 53.

—**The Conference Skydiving Championship** recognize conference champions. The U.S. is divided into 14 conference areas. See USPA Part 54.

—**The National Skydiving Championship** chooses the National Champions and selects the U.S. Skydiving Team. Men and women compete in separate divisions in the individual events, but the team events are mixed.

—**The National Collegiate Parachuting Championship** is for full time undergraduates. Three classes—novice, intermediate and master—compete in style, accuracy, relative work and CRW. See NCPC Part 50.

—**The World Parachuting Championship** takes place each year, with most events scheduled for every other year. Another important international event is the CISM Meet for military sport parachutists.

Service. These positions are appointive or elective. For complete details, see USPA SOPs 5 and 10.

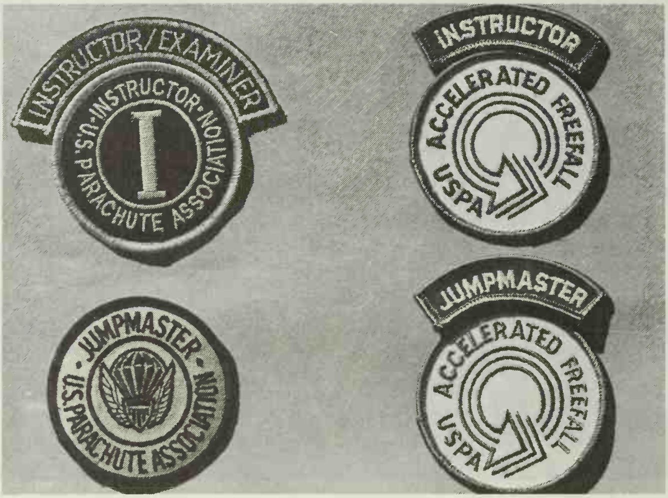
—**Safety & Training Advisor**—The S&TA is an advisor, administrator and representative, appointed by the Conference Director to be his direct representative at the drop zone to which the S&TA is assigned. The S&TA may certify all USPA licenses and advises on night, water and exhibition jumps. He or she may verify annual renewal requirements for all jumpmaster and instructor ratings. There are over 350 S&TA's across North America.

—Director—A member of the USPA Board of Directors elected by the USPA membership to serve as a Conference Director or National Director. Directors meet at least twice annually, serve two-year terms, and may be re-elected. See SIM, Sec. 1-1.

—Conference Director—Elected by members of the 14 conference areas. Has equal representation with National Directors on the USPA Board of Directors.

—National Director—Elected by all the general membership. Represents all the members in the USPA (*Ministers without Portfolio*). Usually elected for their ability to make particular contributions to the sport. The Board has eight National Directors.

—Officer—Elected by the Board of Directors from among members of the Board. Elected every two years with the seating of each new Board. There are four USPA Officers: President, Vice-President, Secretary and Treasurer. They sit on an Executive Committee along with the Chairman of the Board, an at-large member.



Jumpmasters, instructors and examiners supervise student training

Instruction. Competence in the instruction and supervision of students and (when required) other parachutists is assured by a system of three ratings. Separate ratings are issued to static-line jumpmasters and instructors and AFF jumpmasters and instructors. See *The Skydiver's Information Manual.*

—**Jumpmasters** (JM) dispatch students from aircraft. They provide practical instruction and direct supervision for students in the aircraft, on static line and in solo freefall.

—**Instructors** (I) teach skydiving. They instruct students in the theoretical and practical skydiving skills required to attain a USPA A license.

—**Instructor/Examiners** (I/E) have passed extensive written and practical tests. I/E's may verify applications for all USPA licenses and USPA ratings, as well as provide guidance for night, water and exhibition jumps.

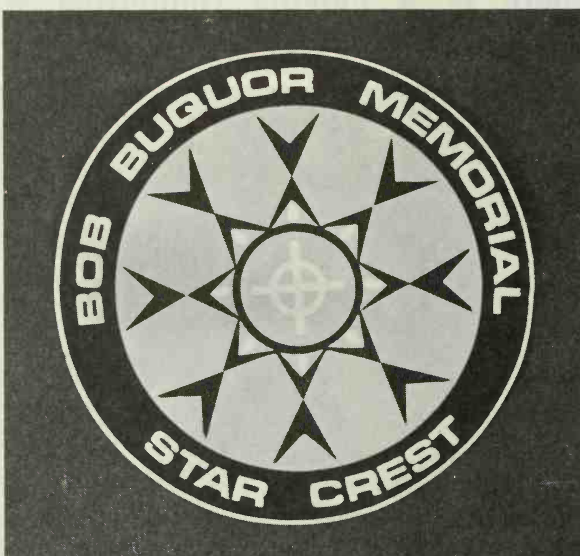
Judging. Where there is competition, there must be judges; competitive events, by their very nature, require evaluation. While judges used to stand in the sun with high power spotting scopes, now they sit in air-conditioned rooms, staring at video monitors.

There are three levels in judging: Conference, National and International, and judges are rated before they may judge each type of event. Before a judge is selected to judge a National Championship, he or she must complete a judge training program at a previous Nationals. After several years of exceptional work, he or she may be nominated for the FAI International Judges' List. Judges maintain log books to record the competitions they work, and there is a judging committee which constantly monitors their progress.

Others have developed a high level of proficiency in scoring, recording and other support positions

Other ratings and awards in the field of parachuting are issued by the Federal Government and private groups. These are in addition to the USPA recognition mentioned earlier.

Parachute riggers are certified by the Federal Government through the Federal Aviation Administration. One may become a *Senior Rigger* after considerable schooling and a battery of tests, written, oral and practical. After working for three years in the field and packing at least 200 parachutes, he or she is eligible to take other tests to qualify as a *Master Parachute Rigger*. For more information, see Federal Aviation Regulation, Part 65, *Parachute Rigging Course* and *Parachute Rigger Study Guide*, listed in the Appendix. .



The Star Crest

The Star Crest is a series of awards for achievement in relative work, established and conducted by Bill Newell in memory of Bob Buquor, the parachuting photographer who was primarily responsible for the development of large star relative work. The

basic SCR is issued to anyone who takes part in an eight or larger star for a minimum of five seconds. Very difficult to learn in the early days, over 22,000 Star Crests have been issued to date. The SCS (Star Crest Solo) is for those who have entered the star eighth or later, as this is a bit harder than going out and playing base for a bunch of good flyers. Seventy-five hundred Star Crest Solos have been issued so far. Over 2,200 skydivers have qualified for their NSCR by making an 8-way at night. For information, write Bill Newell, 3418-A Mona Way, Bakersfield, CA 93309. Another variation is the WSCR for female-only jumps. This program is administered by Bill Stage, P.O. Box 5455-B, Long Beach, CA 90805.

INTERNATIONAL SPORT AVIATION
competition and records

Fédération
Aéronautique
Internationale

Commission
Internationale
de Parachutisme

National
Aeronautic
Association

United States
Parachute
Association

International sport aviation. The official national organization of sport parachutists in the United States is the United States Parachute Association (USPA), a non-profit division of the National Aeronautic Association. The USPA is the official representative of the Federation Aeronautique Internationale (FAI) for parachuting in the United

States, and it is the national representative body for parachutists, drop zones, parachute riggers and the parachute industry. It is the only organization sanctioning sport parachuting competition and records in the United States.

Join the USPA and become part of the great world-wide fraternity of parachuting; get *Parachutist* magazine and find out what's happening. For more information and an application blank, write USPA, 1440-P Duke Street, Alexandria, VA 22314. (703) 836-3495.

In Canada, write the Canadian Sport Parachuting Association, 4195 Dunning Road, RR #3, Navan, ON K4B 1J1, Canada. (613) 835-3731.

Skydivers know why the birds sing.

Appendix

For More Information

Parachute Clubs and Centers

Drop zones are located all over North America. To locate the one nearest you, look under "Parachutes" and/or "Skydiving instruction" in the *Yellow Pages* of the applicable telephone directory, and call the airport in the location listed. Or, call the associations listed below for the address of your nearest certified school.

United States Parachute Association
1440-P Duke Street
Alexandria, VA 22314
(703) 836-3495

Other organizations which may be contacted through the USPA include:

- National Collegiate Parachuting Committee
- National Parachute Riggers' Association
- Drop Zone Owners & Operators Association
- Parachute Industry Association

Canadian Sport Parachuting Association
RR#3, 4195 Dunning Road
Navan, ON K4B 1J1
(613) 835-3731

Parachuting Around the World

Argentina: Fed. Argentina de Paracaidismo, Anchorena 275, Buenos Aires.
Australia: Australian Parachute Fed., P.O. Box 144, Curtin, ACT 2605.
Austria: Aeroklub, Prinz Eugen Strasse 12-P, A-1040 Wein.
Belgium: Aero Club. 1, rue Montoyer, B-1040 Brussels.
Brasil: Rua Visconde de Maya 1320, 60000 Fortaleza, CE
Bulgaria: BAF, Christo Botev 48 Sofia 1000.
Canada: CSPA, RR#3, 4195 Dunning Road, Navan, ON K4B 1J1.
Chile: Fed. Area, Casilla 1074, Santiago.
China: Aero Club, 9 Tiyuguan, Beijing.
China: R.O.C. Parachute Assn., 59, Pei An Road, Taipei, 104, Taiwan.
Danmark: Dansk Faldskaerms Union, Romersgade 19, III, DK-1362 Kobnhavn.
Finland: Aero Club, Malmin Lentoasema, SF-700 Helsinki.
France: F.F.P., 35-P Rue St. Georges, Paris 9e.
Germany: Deutscher Aero Club c.v., P.O. Box 710123, D-6000 Frankfurt, 71
Great Britain: BPA, 47-P Vaughan, Leicester LE1 4SG.
Indonesia: AVES SPC, Djuanda 262-P, Bandung.
Ireland: Irish Aviation Club, Dublin Airport.
Israel: Aero Club, P.O. Box 26261, Tel-Aviv.
Japan: Japan RW Parachuting Assn., 1-44-10 Higashi, Tigers 802, Ikeburo, Toshimaku, Tokyo.
Korea: Aero Club, 132-S, 1-KA Bongnae Dong, hoong-ku, Seoul. And U.S. Forces in Camp Humphreys.
Mexico: Club Para. de Mex., Lerdo No. 210, Mexico 3, D.F.
The Netherlands: K.m.v.V.L.A.P., Josef Israelsplein 8, NL-2596 Den Haag.
New Zealand: NZ Para Fed., P.O. Box 10109, Balmoral, Auckland.
Norway: Norges Lufsportforbund, P.O. Box 9514, N-0159 Oslo 1..
Phillippines: PPF, Vito Cruz St. Rizal Sports, Manila. And, U.S. Forces in Cubi Point and Clark Air Base.
Spain: FENDA, c/o Ferraz No. 16-P, Madrid.
Sweden: SPA, KSAK, Malgomajvagen 17, S-12172 Johanns.
Switzerland: Aero Club, Lidorstrasse 5-P, CH-6006 Lucerne.

USA: U.S.P.A., 1440 Duke St., Alexandria, VA 22314.
USSR: Aero club, P.O. Box 395, Moscow 123362.
Venezuela: Para Club Caracas, Apartado 80016-P, Caracas 108.
In other countries, check with the national aero club.

Parachute Equipment Companies

The following parachute dealers have catalogues or extensive brochures.

The RW Shop
Rt #13, Box P
Brookline, NH 03033
(Catalogue $1.00)

Cummings Rigging Works
15 Gaynor Avenue #2H
Manhasset, NY 11030

Para-Flite, Inc.
5800-P Magnolia Avenue
Pennsauken, NJ 08109
(Free brochures)

Parachute Associates, Inc.
P.O. Box 428
Lumberton, NJ 08048

National Parachute Indust.
47 East Main Street
Flemington, NJ 08822
(Free brochures)

The Chute Shop
Highway 202
Flemington, NJ 08822

Para Loft, Inc.
Dave DeWolf
26 West Bainbridge
Elizabethtown, PA 17022

USPA Store
1440-P Duke Street
Alexandria, VA 22314
(Free brochure)

Astroid, Inc.
Rt#3, Box 336-A
Asheboro, NC 27203

Aerosports
Hwy 27-A, Roosevelt Airport
Warm Springs, GA 31830

Skydive DeLand
P.O. Box 3071
DeLand, FL 32720

Aero Graphics
P.O. Box 1520
DeLand, FL 32721
(Book brochure)

Jump Shack South
1665 Lexington Ave. #106
DeLand, FL 32724

Paragators
Star Route #1, Box 462
Eustis, FL 32727

Strong Enterprises, Inc.
11236-P Satellite Blvd.
Orlando, FL 32821
(Catalogue $1.00)

Aeroloft Sales and Service
P.O. Box 386
Dunlap, TN 37327

Cleveland Parachute Center
15199 Grove Road
Garrettsville, OH 44231
Greene County Paraenter
Jim West
177 Monroe Siding
Xenia, OH 45385

Parachuting Service
Harold Lange
197 Burt Street
Tecumseh, MI 49286

Relatively North
Sonny Thoren
248 North Main Street
L'Anse, MI 49946

Wisconsin Parachute Service
W. 192 N. 4944, One Mile Rd.
Menomonee Falls, WI 53051

Sky Knights Para Club
P.O. Box 817
East Troy, WI 53120

South Dakota Skydivers
1713 Shellynn Drive
Sioux Falls, SD 57103

Poverty Flats Air Sports
P.O. Box 597
Glendive, MT 59330

Para-Gear Equipment Co.
3839-P Oakton Street
Skokie, IL 60076
(Catalogue $2.00)

Greater St. Louis Pcht Club
P.O. Box 254
Edwardsville, IL 62025

Kansas Sky Ranch
RR#3, Box 12-A
Udall, KS 67146

Janousek's Lincoln Paraloft
929-P Furnas Avenue
Lincoln, NE 68521

Adventure Loft
1425 Century #100
Carrollton, TX 75006

Spaceland Parachute Center
2750 FM 1266
League City, TX 77573

Westex Skysports
1608 North Garfield
Midland, TX 79701

San Diego Air Sports Center
13531 Otay Lakes
Jamul, CA 92035

Elsinore Sky Systems
Chuck Embury
33330 Westlong Street
Lake Elsinore, CA 92330

Rigging Innovations
236 East Third Street
Perris, CA 92370

Square One Parachute Sales
2095 Goetz Road
Perris, CA 92370

California City Pcht Club
6284 Curtiss Place
California City, CA 93505

Para Publishing
P.O. Box 4232-P
Santa Barbara, CA 93140
(Free brochure)

Sky-I Parachutes
55 Mercury
Hollister, CA 95023

Lodi Parachute Center
P.O. Box 423
Acampo, CA 95220

Action Air
Rt #2, Box 2410-A
Davis, CA 95616-9734

Quantum Parachutes
720 Olive Drive #Y
Davis, CA 95616

Western Parachute Sales
29388 S.E. Heiple Road
Eagle Creek, OR 97022

Para-Phrenalia
1045 12th Ave. NW #F-8B
Issaquah, WA 98027

Northwest Aero Sports
6478-P Guide Meridian
Lynden, WA 98264

And

Parachutes Australia
68 Wentworth Avenue
Sydney NSW 2010
Australia

Southern Cross Parachutes
P.O. Box 21-P
Doveton, Victoria 3177
Australia

Niagara Parachutes Ltd.
P.O. Box 927-P
Niagara Falls, Ont. L2E 6V8
Canada

Horizon Aero-Sports
1059 West Broadway
Vancouver, BC V6H 1E2
Canada

Westway Parachute Ent.
P.O. Box 37
New Hamburg, ON N0B 2G0
Canada

Scan Para.
Smedegade 3, Snoldelev
DK-4621 Gadstrup
Danmark

Parachutes de France SA
BP 247
F-95523
Cergy-Pontoise Cedex
France

Stadium
3 Largo Attias
1-57100 Livorno
Italia

Parachutes & Para Equipt
P.O. Box 2032-P
Wellington
New Zealand

Parachutes Norway
P.O. Box 106
N-2070 Raaholt
Norway

KATO Marketing A/S
P.O. Box 2731-P
St. Hanshaugen, Oslo 1
Norway

Tom's Para-Salg
P.O. Box 167
N-1344 Haslum
Norway

Swedish Paraservice
3:e Langgatan 13
S-41103 Goteborg
Sweden

Parawing, SA
P.O. Box 106
CH-6850 Mendrisio
Switzerland

Para-Centro Locarno
Aeroporto Cantonale
CH-6596 Gordola-Locarno
Switzerland

Fallschrimsportartikel
Am Hasengarten 45
D-3300 Braunschweig
West Germany

Books

Write for latest price and delivery information or see your local parachute dealer.

Blackmon, Deborah. *Parachute Rigger Study Guide*. 1989. Para Publishing, P.O. Box 4232-P, Santa Barbara, CA 93140-4232. Answers and explanations for the FAA test questions.

Blackmon, Deborah. *The Rigger's Sourcebook*. 1988. Bravo Bravo Aviation, 17494 Cottrell Blvd. Suite 442, Lake Elsinore, CA 92330. Compilation of packing instructions.

Butler, Manley. *How to Get an FAA TSO for Parachutes*. 1984. Butler Parachutes, 6399 Lindbergh Blvd., California City, CA 93505

Dubuis, Bertrand. *Paragliding, The Manual*. 1987. Ulico, Inc., P.O. Box 2055, Marieville, PQ J0L 1J0, Canada. Foot-launching ram-air canopies.

FitzSimons, Bill. *Skydiving, a Dictionary*. Fodderstack Press, P.O. Box 38, Flint Hill, VA 22627. Humor.

Gregory, Howard. *Parachuting's Unforgettable Jumps* III. 1986. Howard Gregory Associates, 640 The Village #209, Redondo Beach, CA 90277. A historical view of both airborne and sport jumping.

Keech, Andy. *Skies Call*. 1981. Skies Call, P.O. Box 57238, Washington, DC 20037. Outstanding color photos by a gifted parachuting photographer. Three volumes.

Nelson, Carl. *Body Pilot*. 1981. Freakfanalia, J. Nelson, Rt #34, Skyline Center, Sandwich, IL 60548. Well-illustrated how-to on relative work.

Parsons, Terry. *Canopy Relative Work*. 1983. Skydiving Book Service, P.O. Box 1520, DeLand, FL 32721. All about CRW.

Poynter, Dan. *Parachuting Manual with Log*. 1984. Para Publishing, P.O. Box 4232-P, Santa Barbara, CA 93140-4232. A brief, basic round canopy/conventional gear, text for the novice.

Poynter, Dan. *Parachuting Manual with Log For Square/Piggyback Equipment*. 1988. Para Publishing, P.O. Box 4232-P. Santa Barbara, CA 93140-4232. A brief, basic square canopy and piggyback container, text for the novice.

Poynter, Dan. *Parachute Rigging Course*. 1981. Para Publishing, P.O. Box 4232-P, Santa Barbara, CA 93140-4232. A course of study for the FAA senior rigger certificate.

Poynter, Dan & Blackmon, Deborah. Parachute Rigger Study Guide. 1989. Para Publishing, P.O. Box 4232-P, Santa Barbara, CA 93140-4232. Answers and explanations for the FAA test questions.

Poynter, Dan. *Parachuting Instructor/Examiner Course*. 1978. Para Publishing, P.O. Box 4232-P, Santa Barbara, CA 93103-4232. A home study course for the USPA I/E rating.

Poynter, Dan. *The Parachute Manual*. 1984. Para Publishing, P.O. Box 4232-P, Santa Barbara, CA 93140-4232. A technical treatise on the parachute; of special interest to parachute riggers.

Poynter, Dan. *Parachuting, The Skydiver's Handbook*. 1989. Para Publishing, P.O. Box 4232-P, Santa Barbara, CA 93140-4232. The most detailed and accurate basic-to-intermediate text on the sport.

Poynter, Dan. *Paracaidismo.* Para Publishing, P.O. Box 4232-P, Santa Barbara, CA 93140-4232. *Parachuting, The Skydiver's Handbook* in Spanish.

Poynter, Dan. *Manual Basico de Paracaidismo.* Para Publishing, P.O. Box 4232-P, Santa Barbara, CA 93140-4232. *Parachuting Manual With Log* in Spanish.

Shea-Simonds, Charles. *The Complete Sport Parachuting Guide.* 1986. A & C Black, London. A popular text on British parachuting.

Works, Pat and Jan. 1988. *The Art of Freefall Relative Work.* Skydiving Book Service, P.O. Box 1520, Deland, FL 32721.

Owner's Manuals. The manufacturers of sport and emergency parachutes also publish manuals that describe the use, packing and maintenance of each particular assembly. These manuals should always be read by the owner or rigger of the parachute, and they are also excellent sources of accurate and detailed information for the parachute instructor. Most manuals may be obtained for a small fee (usually about $1) by writing directly to the manufacturer.

Parachute Magazines and Newsletters

Write for a sample copy and a subscription blank.

Parachutist Magazine
1440 Duke Street
Alexandria, VA 22314

Skydiving Magazine
P.O. Box 1520
DeLand, FL 32721

PIA Para Newsbriefs
1440 Duke Street
Alexandria, VA 22314

Sp. Parachutist's Safety Jrnl
Jan Meyer
1663 East Glenn
Tucson, AZ 85719

CPI Newsletter
P.O. Box 953
Manchester, CT 06040

Paragliding Review
8125 Burthe Street
New Orleans, LA 70118-1111

Skydiving Spotlight
1716-P North 58th Street
Superior, WI 54880

Peregrine
1437 Stetson Street
Woodland, CA 95695

BASE Magazine
12619 South Manor Drive
Hawthorne, CA 90250

And

Rambling On
15 Wynnum Road
Norman Park, QLD 4170
Australia

Fallschirmsport Magazin
C. v.-Hotzendorfstrasse 29
A-8010 Graz
Austria

Human Flight Magazine
P.O. Box 133
A-9021 Klagenfurt
Austria

Espacio Aereo Deportivo
Anchorena 275
1170 Buenos Aires
Argentina

Can Para Magazine
95 Gilmore Road
Fort Erie, ON L2A 2L9
Canada

Prairie Parachutist
920 Ninth Avenue SW #1902
Calgary, AB T2P 2T9
Canada

CSPC Newsletter
P.O. Box 80061
South Hornby, BC V5H 3X1
Canada

La Revue Parachutiste
1415 est. rue Jarry
Montreal PQ H2E 1Z7
Canada

Maritime Para-News
P.O. Box 33, B0P 1G0
Cambridge Station, NS
Canada

Laskuvarjourheilu
Mechelininkatu 6, A, 11
SF-00100 Helsinki
Finland

ParaMag
50 rue de Chabrol
F-75010 Paris
France

FFP Info
35, St-Georges
F-75009 Paris
France

Slope Soaring
7, rue de la Condrale
F-67500 Hagenau
France

Sport Parachutist Magazine
Kimberly House, 47 Vaughan
Leicester, LE1 4SG
Great Britain

Skywalker (parascending)
18 Talbot Lane
Leicester, LE1 4LR
Great Britain

Informazione Magazine
M. Valbonesi, Stadium
Piazza Attias 3
1-57100 Livorno
Italia

Paracadutismo
C.P. 107
I-46100 Mantova
Italia

Japan RW Parachuting
1-44-10 Higashi, Tigers 802
Ikeburo, Toshimaku
Tokyo
Japan

Sportparachutist Magazin
KNVvL, Josef Israelsplien 8
NL-2596 AS 's-Gravenhage
The Netherlands

Free Fall Kiwi Magazine
Jim Scorrar
RD #1
Clevedon
New Zealand

Fritt-Fall Magazin
Audun Wik
Fougstadgt 51
N-0173 Oslo
Norway

Svensk Fallskarmssport
Box 3093
S-580 03 Linkoping
Sweden

Skydiver Magazine
Brunnenstr 35
D-8959 Reiden an Forggensee
West Germany

USPA Publications

Order from the USPA Store, 1440-P Duke St., Alexandria, VA 22314. Write for a complete list of the latest publications.

Skydiver's Information Manual
FAI Sporting Code
Federal Aviation Regulations, Parachute Jumping—FAR 105
FAA Advisory Circular, Sport Parachute Jumping—AC 105-2A

Federal Aviation Administration Publications

FAA regulations may be obtained from local FAA offices, most parachute equipment dealers and the Superintendent of Documents.

Part 37—*Technical Standard Order Authorizations*. FAR 37 prescribes procedures for obtaining a TSO and other related regulations.

Part 65—*Certification of Airmen Other Than Flight Crewmembers*. This details the requirements and procedures for becoming an FAA Parachute Rigger.

Part 91—*General Operating and Flight Rules*. This Part establishes federal regulations for general flight operations in the U.S.

Part 105—*Parachute Jumping*. This regulation covers skydiving operations, instruction and equipment.

Part 149—*Parachute Lofts*. Gives requirements for issuing parachute loft ratings and general operating rules for FAA certificated lofts.

Parachute Rigger Certification Guide (Advisory Circular 65-5A). This booklet gives detailed information on how to apply for an FAA Rigger Certificate. Included are sample questions from the written exam and other useful information.

Use of Oxygen (Advisory Circular 91-8A). This publication gives recommended and required procedures for the use of supplemental oxygen during flight.

Airman's Information Manual, Part 1, Basic Flight Manual and ATC Procedures. Published primarily for pilots, this book contains current information on all aspects of using U.S. airspace and airports. It is useful to the sport parachuting instructor who wants to know the latest word on all details of navigation aids, ATC procedures, airspace structure, pilot-controller terminology. Issued four times per year.

Parachuting Films and Video Tapes

Training, packing and just plain fun, there are videos on every aspect of parachutes and skydiving. Write for descriptive brochure and current prices.

U.S. Parachute Association
1440-P Duke Street
Alexandria, VA 22314
(703) 836-3495

Norman Kent Productions
P.O. Box 54309
Los Angeles, CA 90054
(818) 761-3281

Photo-Chuting Enterprises
Jean Boenish
12619-P South Manor Drive
Hawthorne, CA 90250
(213) 678-0163

FB Productions
Rt #34, Skyline Center
Sandwich, IL 60548
(815) 786-8200

Precision Aerodynamics
P.O. Box 691
Dunlap, TN 37327
(615) 949-4688

AFF East, Inc.
3506 Airport Road
Chambersburg, PA 17201
(717) 264-1111

Big Sky Films
B. J. Worth
P.O. Box 626-P
Whitefish, MT 59937

Mike McGowan
P.O. Box 3481
DeLand, FL 32723

BPS Productions
P.O. Box 19378
Los Angeles, CA 90019

Bulsh Productions
15-P Wynnum Road
Normal Park
Brisbane, Q1D 4170
Australia

Glossary—Index

This unique glossary/index is designed to help you learn the language of skydiving. Each term is defined and referenced to the text. Study these essential terms until you can not only define them, but explain them.

Approved: An item which, in its present form, has received official certification from the FAA. This approval may be indicated by a TSO stamped on the article or carry a military designation such as NAF, AAF, or AN. Any surplus military parachute has been *approved* at time of manufacture. If the parachute is altered, such as removing a gore from the canopy, installing D rings on the harness, adding a sleeve, etc., it is no longer an *approved* parachute. 245

APT: Army Parachute Team, The Golden Knights. 97, 342

AS-8015A: Aerospace Standard 8015A, published by the Society of Automotive Engineers, sets forth the tests and minimum safety and performance standards which a parachute must meet to receive approval under TSO C-23c. 246

Aspect ratio: The ratio between the span and the chord of a wing. For rectangular canopies, it is the span divided by the chord. 268, 272

Automatic Activation Device (AAD): A self-contained device attached to the ripcord assembly, other than a static line, which automatically initiates parachute pack opening at a preset altitude, time, percentage of terminal velocity, or combination thereof. 25, 97, 106, 297

Auxiliary parachute: FAA: Reserve parachute. British: Pilot chute.

Awards: 349

B License. USPA's second level license. 96, 348

Back sliding: Moving backward in freefall, usually with the head high and the feet low. Chapter 5

Barrel Roll: 201

Bag lock: 135

BASE jumping. (Buildings, Antenna, Span, Earth). Fixed object jumping, rather than from aircraft. 340

Basic freefall position: 189

Basic parachutist course: The course of instruction in sport parachuting beginning with the first jump training and progressing through all the novice skills and knowledge needed to qualify for the A License. After successfully completing the Basic Parachutist Course, the parachutist is fully capable of

safe and competent parachuting without a jumpmaster's supervision. Chapters 1, 2 and 5

Basic safety requirements: Minimum requirements which are essential for safe sport parachuting activities. Formulated by the USPA. 25, 164

Batwings: Large rigid or semi-rigid surfaces which are attached to the arms and body to decrease rate of descent and increase glide. See Jumpsuit.

Board of directors: Those officials elected by the general membership of the USPA every two years as set forth in the USPA By-Laws; authorized by the By-Laws to have general charge and control of the affairs, funds and property of the organization; shall carry out the objectives of the organization and its By-Laws; elects officers from among current Board members. The USPA Board of Directors shall consist of:

a) National Directors—those Directors elected at large by the general membership; and b) Conference Directors—those Directors of a specified geographical area, elected by and responsible for, representing the interests of the parachutists of his Conference area. 357

Books: 368

Boots: 304

Brakes: 262

Break Off: Separation after a formation in RW or CRW. 197, 208

Breakaway: A jettisoning of the malfunctioned main parachute by activating riser releases and deploying the reserve. See *Cutaway*. 18, 143

BSR: Basic Safety Requirements

Buffeting. Rocking up and down in freefall. Occurs when the skydiver is too stiff, or not relaxed. 178, 188

Buying a parachute: 328

C license: USPA's third level license. 96, 348

Camera jumping: 337

Canadian Sport Parachuting Association: The organization which governs sport parachuting activities in Canada. 362

Canopy: The sheet of fabric and lines of a parachute assembly that provides necessary deceleration for a survivable landing. 9, 58, 60, 264, 272, 277

Canopy relative work (CRW): The intentional maneuvering of two or more open canopies in close proximity or contact with each other during descent. 13, 236, 279, 351, 356

Canopy releases: Devices which allow immediate release of the main parachute canopy. They disconnect the harness main lift webs from the risers. One type is manufactured by Capewell and is sometimes called the *Capewell Release*. Another example is the 3-Ring release. 286

Canopy transfer: Deploying the reserve canopy prior to jettisoning the main canopy. Subscribed to by some, when the main is damaged or tangled at a low altitude, usually on a CRW jump. 147, 279

Capewell: A hardware manufacturer in Hartford, Connecticut. 287

Care of the parachute: 326

Caterpillar Club: Established by Leslie Irvin for those who have saved their lives with a parachute. 91

CCR: Canopy Crest Recipient. 360

CCS: Canopy Crest Soloist. 360

Cell: 270, 272

Certificated: Describes a personnel parachute which has been awarded an FAA TSO Certificate. Also used to refer to other FAA-approved parachutes such as government surplus personnel models which were manufactured under military contract. FAA also uses the term to describe persons it has approved for various functions such as pilot, rigger, etc. 245

Chord: The distance from the leading edge to the trailing edge of a ram-air canopy. 271, 272

CIP: Commission Internationale de Parachutism. An FAI Commission. 209

Cloth extensions: Small triangular pieces of cloth normally sewn into the armpits, between the thighs, etc., of the jumpsuit to slow the rate of descent during freefall and to increase the glide ratio. These are not *batwings*. See jumpsuit.

Closing speed: The speed at which two bodies approach each other. Can refer to RW or CRW.

Compatible: Two parts of a parachute, such as a harness/container system and a canopy, which have been tested and been found to work together.

Competition: 12, 209, 352

Conference Director (CD): A USPA director elected to represent jumpers in a specific geographical area. 357

Connector links: 292

Convection currents: 66

Container: That portion of the parachute assembly which holds the canopy in place after being folded. This is not to be confused with the term *pack*. 242, 282

Control lines: 276

Count: 54

Crabbing: Directing the canopy across the line of wind direction. 62

Cross pull: The position of the ripcord handle on the left-hand inboard side of the harness. An inboard pull or cross-chest pull.

Cross connector straps: Straps running from riser to riser. On student rigs, they run side to side to prevent canopy collapse if one canopy release fails to separate. On CRW rigs, they run from front to rear to prevent sliding back up the risers during planes.

Crossports: Vents cut in ribs of ram-air canopies to ensure even pressurization. 242, 272

CRW: Canopy Relative Work.

CSPA: Canadian Sport Parachuting Association

Cutaway: The cutting of risers or suspension lines with a knife to release the deployed canopy while the parachutist is still in the air. Also used interchangeably with *Breakaway*.

D license: USPA's highest license. 13, 96, 97, 348

Delayed drop: A live parachute descent where the activation of the parachute is delayed longer than is necessary to clear the aircraft. Skydiving makes the term obsolete.

Delayed opening: The normal deployment of a parachute, delayed by an automatic device. See freefall.

Delta position: A modified stable freefall position made by a jumper drawing the arms back near the sides, which results in a head-low attitude and increases his or her rate of descent and horizontal movement. 192, 197, 213

Demonstration jump: A jump made away from an established drop zone for the benefit of spectators. Also called an *exhibition jump* or *display jump*. 339

Deployment: That portion of a parachute's operation occurring from the moment of pack opening, or pilot chute release, to the instant the suspension lines are fully stretched, but prior to the inflation of the canopy. 56, 58

Deployment bag: An envelope, usually fabric, and usually enclosed in a parachute pack, containing a parachute canopy. Means may, or may not, be provided for stowage of suspension lines. A pilot parachute lifts a deployment bag away from a parachute pack, causing the suspension lines to be extended before the canopy emerges from the deployment bag. 56, 242, 248, 257

Deployment device: A sleeve, bag, diaper or other device used to provide orderly lines-first deployment and to reduce opening shock. 256

Diaper: A deployment device consisting of a panel of fabric attached to the lower part of a canopy which prevents canopy inflation until line stretch. Reduces opening shock and malfunctions. 258

Direct supervision: A person physically present during instruction in skydiving or rigging. The supervisor is responsible for the actions of those supervised.

Doctrine: Principles, policies and concepts applicable to a subject, which are derived from experience or theory, compiled and taught for guidance. It represents the best available thought that can be defended by reason. Doctrine on each phase of parachuting is published by the USPA.

Door exit: Leaving an aircraft without touching any part of the aircraft outside of the door; made without positioning or bracing to achieve a stable fall position. 206

Downplane: Where two (or more) CRW jumpers grip (usually at the legs) to face the leading edges of their canopies toward the ground. The result is dramatic, high-speed flying—straight down.

Drogue: A smaller canopy deployed to slow and stabilize the load, usually prior to main canopy deployment. A drogue chute is used on tandem jumps. 245

Drop altitude: Actual altitude of an aircraft above the ground at the time of release of equipment or personnel.

Drop zone: A specified area into which personnel or equipment are dropped by parachute. 14

Dual assembly: A two canopy parachute system.

Dummy Ripcord Pull (DRCP): see Practice RipCord Pull.

DZ: Drop zone.

Emergency Parachute: A certificated parachute which is intended for emergency use. 8

Equipment check (*pin check*): A visual and physical check made by the jumpmaster on all parachutists, prior to boarding and prior to exiting the aircraft. 36, 307

European Parachuting League: An affiliate of the USPA, which looks after the members' interests in Europe.

Exhibition jump: A demonstration jump made away from a recognized drop zone for the benefit and instruction of spectators, the sole purpose of which is not a record attempt. The preferred term is *demonstration jump.* 339

Exit: 48, 51

Exit point: The place where a jumper exits the aircraft. 44, 220. See Spotting.

Exit weight: The weight of a jumper, including all equipment. 60

FAR: Federal Aviation Regulation. 24, 245, 372

Federal Aviation Administration (FAA): The FAA's primary function and responsibility involves control and monitoring of the nation's air space; the certification of all civil aircraft and engines; licensing of all civil pilots, mechanics; administration of the Federal Aid to Airports Program, and

operation of the two federally owned civil airports serving Washington, D.C. 24, 245, 372

Federation Aeronautique Internationale (FAI): A multinational organization that governs all aviation sports, establishes all official aviation records and sanctions official international competitions. Operates through a non-profit National Aero Club in each country. 361

Field packing: The temporary stowing of the canopy, etc., in the container after a jump, so that it may be more easily transported to the packing area. 77

Fitting the parachute assembly: 305, 349

FJC: First jump course.

Flare: A temporary reduction in the vertical and horizontal speeds of a ram-air canopy, performed during landing by pushing both steering toggles down. 71

Flying the canopy: 56, Chaper 6

Forward loop: 202

FPS: Feet per second.

Freefall: A skydive in which the parachute is activated manually by the jumper at his or her discretion. The portion of the jump between exit and canopy deployment. 13, 111, 187, Chapter 5

Freestyle: 215

Frog position: A modified stable freefall position made by the parachutist without an arch, with the legs slightly bent and the arms in a U position. 189

FSDO: Flight Standards District Office.

Go toggles: A non-locking front riser pulley system for mechanical advantage used during CRW.

Glide: The horizontal and vertical flight of a descending canopy. 264

Gloves: 304

GMM: General Membership Meeting of the USPA or CSPA, which are held once each year.

Goggles: 303, 308

Gravity: One law that can't be waived in skydiving. 60

Grip: 214

GW: Gold wings.

HAHO: High Altitude, High Opening. A type of military jump.

HALO: High Altitude, Low Opening. A type of freefall military jump. 342

Hand deploy pilot chute: The springless pilot chute used in hand deploy parachute systems. See *throw-out, pilot chute* and *pull-out pilot chute.*

Hardware: 132

Hard pull: 132

Harness: An arrangement of cotton, linen or nylon webbing, which is designed to conform to the shape of the load to be carried. It secures the load properly, so that the opening shock and the weight of the load are evenly distributed during the descent. 242, 282, 310

Hazards, parachuting: Ditches, telephone and power lines, poles, towers, houses, buildings, hangars, automobiles, highways, airplanes, trees over 30 feet in height, water and any other obstacles or object which would cause death or severe injury to the jumper. 116

Helmet: 303, 308

Hesitation: When the pilot chute momentarily flutters in the low pressure area behind the jumper, rather than catching air. 132

High altitude jumps: 336

Holding: Facing the canopy into the wind to minimize ground speed. 62

Hook knife: A knife with a "U" shaped blade designed to cut suspension lines. 305

ICC: Instructor Certification Course.

I/E: Instructor/Examiner: 358

Instructor: The holder of this rating possesses all privileges of a USPA jumpmaster, and is certified as capable of safely and competently instructing student and novice parachutists in the parachuting skills required to attain the USPA Class A License. 24, 183, 358

Instructor Assisted Deployment: When the instructor holds the pilot chute in the airstream while the student exits; the static line is eliminated. 19

Instructor Certification Course: A course registered with, and approved by, the USPA conducted to train, qualify and certify USPA instructors. 358

Instructor/Examiner: Possesses all privileges of a USPA instructor. An I/E is capable of instruction in all areas of parachuting, including accuracy, style, RW, night, water and high altitude jumps. The I/E is capable of briefing news media and the general public, as well as state and local government agencies, concerning parachuting. 358

Instructor seminar: A gathering of five or more USPA instructors and/or Instructor/Examiners to exchange, discuss, and introduce new ideas to develop, improve, or assure the quality of techniques of instruction of sport parachuting. 358

Insurance: 24

International parachuting license: An FAI training, competitive, or exhibition parachuting license, issued by the USPA to qualified applicants who meet the minimum requirements as set forth by the USPA, and verified by a USPA, S&TA, USPA instructor, or other designated official. 347

JCC: Jumpmaster Certification Course.

JM: Jumpmaster.

Judge: An official who evaluates competitive parachuting performance. 359

Jump and pull (*hop 'n pop*): Pulling the ripcord immediately upon clearing the aircraft (within three seconds). 19, 175. See Clear & Pull.

Jump run: The level predetermined flight of the aircraft at reduced airspeed prior to exit. 45

Jumpmaster: JM. 1. The parachutist in command of other parachutists from the time they enter the aircraft until the time they exit; usually the senior jumper. Also called the *jump leader*. 2. Holder of a USPA jumpmaster rating. 46, 183, 358

Jumpmaster Certification Course: A course registered with and approved by the USPA conducted to train, qualify, and cer-

tify USPA Jumpmasters as outlined by the JCC Guide Book. 358

Jumpmaster workshop: A gathering of five or more persons who hold the USPA Jumpmaster rating, assembled to exchange and discuss techniques and information to improve and insure the quality and effectiveness of their performances as Jumpmasters. 358

Jumpsuit: 300

Knife: 305

Landing the parachute: 67, 68, 75, 112, 151, 235

Lift-to-drag ratio: $^{L}/_{D}$. The lift generated by the canopy divided by the drag produced, expressed as a ratio. 269

Line dock: An advanced CRW technique where one canopy is above the head of the person receiving the dock.

Log book: 28, 79

Low pressure area: 133

Magazines: 370

Main parachute: The primary parachute of a dual (two canopy) assembly. 242, 243, 247

Maintenance: Inspection, overhaul, repair, preservation and replacement of parachute parts, but excludes preventive maintenance.

Major alteration: An alteration not listed in the aircraft, engine, or propeller specifications: 1) that might appreciably affect weight, balance, structural strength, performance, powerplant operation, flight characteristics, or other qualities affecting airworthiness; or 2) that is not done according to accepted practices or cannot be done by elementary operations.

Major repair: A repair that: 1) if improperly done, might appreciably affect weight, balance, structure strength, performance, powerplant operation, flight characteristics or other qualities affecting airworthiness; or 2) is not according to accepted practices or cannot be done by elementary operations. The term *major repair* includes replacement of canopy panels, reinforcing tapes, lateral bands, suspension lines, horizontal back straps and diagonal backstraps. 247

Malfunction: The complete or partial failure of the parachute canopy to effect proper opening and descent. Some malfunc-

tions are: canopy damage, twisted suspension lines, bag lock, streamer, an inversion or partial inversion of the canopy. 55, 123, 134, Chapter 4

Medical: 15

Military specification (Mil Spec): A procurement specification promulgated by the military agencies, and used for the procurement of military supplies and equipment.

Minor repair: A repair other than a major repair. Minor repairs includes such operations as: replacing canopies, containers, pack opening bands, cable housings, dual mounting plates, automatic ripcord releases, harness assemblies, repairs to containers; repair of stitching; replacement of harness hardware, where major stitching is not required; replacement of ripcord pockets; patching holes in canopies, etc. 247

Modification: 1) A change. 2) Often refers to the removal of the canopy area of a round canopy to achieve steerability and forward glide.

MSL: Mean Sea Level.

National Aeronautic Association: NAA. The Aero Club representing the FAI in the U.S. The USPA is a division of the NAA. 361

National Collegiate Parachuting Committee (NCPC): An affiliate of the United States Parachute Association. Supports and encourages parachuting as a collegiate sport; assists collegiate parachutists in gaining recognition and support of their school; conducts an annual national collegiate parachuting championship.

National Director (ND): Those directors elected at large by the general membership. 357

Night jump: A parachute jump made from one hour after official sunset to one hour before official sunrise. 332

NOTAM: NOTice to AirMen. An air traffic advisory or notice, filed by an airspace user with an ATC facility.

Novice: A parachutist trainee who has progressed to the aerial phase of training, but who has not qualified for a USPA Class A license.

Open body of water: Any body of water in which a parachutist might drown upon landing. 112

Opening point: The ground point of reference over which the parachutist should open his parachute to enable him to fly to the center of the target area. 67, 220, see Spotting

Opening shock: The deceleration force felt by the jumper when the canopy opens. It is affected by velocity, atmospheric conditions, body position, type of canopy, method of deployment, etc. 276

Oscillation: 1. The swinging of the suspended load under the canopy. 2. In CRW, the swaying or swinging of a CRW formation caused by poor docking, bad air, or too much movement of the people in the formation.

Outboard: Facing to the outside, such as a ripcord facing to the side of the jumper, rather than toward the breast bone.

Pack: Such as back pack or chest pack; and FAA term for the parachute assembly, less the harness. That is, it means the container, canopy, suspension lines, pilot chute, risers and connector links. The term *pack* and *container* are not synonymous.

Pack tray: The portion of the container or deployment device in which the lines are stowed. 283

Packing: 313

Parachute: A fabric device designed to slow the descent of a falling load. The word *parachute* is formed from the French words, *para*, shield or guard against, and *chute*, fall. Thus, *parachute* literally means *to defend from a fall.*

Parachute, free type: A parachute which is not attached to an aircraft but is operated by the jumper at his discretion.

Parachute, static-line operated: A parachute operated by a length of webbing after a jumper has fallen the length of the static line. See Static Line.

Parachute Industry Association (PIA): An association of manufacturers, dealers and suppliers of parachutes and skydiving accessories, based in the U.S. 107, 363

Parachute landing fall (PLF): The method of falling down on landing by which the jumper resists, absorbs and distributes the landing forces over various muscular parts of the body, rather than on just the legs. 68, 70, 72

Parachutist: A person engaging in intentional parachuting, such as a sport parachutist, member of a military airborne unit, or smoke jumper.

Para-Foil: 99, 267

Para-Plane: 267

Partial inversion: A type of round canopy deployment malfunction. It occurs when one or more gore sections near the skirt become inverted during deployment and form a small pocket which inflates, causing a partial inversion of the canopy. The condition may or may not work out, or may become a complete inversion; i.e., the canopy turns completely in-side-out. It is the skirt, not the line, which is *over*; not to be confused with a *line-over*. It is called a *Mae West*. 279

Pattern: 67, 231

PC: Para-Commander canopy. 98, 264, 265

Permeability: See Porosity.

Piggyback reserve: 243

Pilot chute: A small parachute used to accelerate deployment; constructed in much the same manner as a round canopy and from similar material. Some types of pilot chutes are equipped with a spring-operated, quick-opening device. The frame is compressed so as to open immediately when released from the pack. 129, 132, 140, 242, 249, 252

Pilot chute assist system: A temporary connection of break-cord, Velcro, etc., between the static line and the pilot chute of a sport parachute, which pulls the pilot chute out of the pack and into the airstream before it separates. See Static Line.

Plane: A vertical CRW formation, where the grip consists of the feet of one jumper in the risers of another.

Planing: A CRW transition from a stack to a plane.

Pocket, ripcord: 285

Poised exit: A departure from an aircraft in where the jumper uses any external structure to brace himself and to assist in gaining a stable position immediately as he leaves the aircraft. 49

Porosity: Usually refers to what is technically known as *permeability*. The ratio of void or interstitial area to total area of a

Right of way: 66, 168

Ripcord: 122, 148, 184, 251, 284, 308

Risers: 242, 262

Riser dock: A CRW maneuver, involving a momentum dock, that delivers the risers into the hands of the receiver.

Running: Directing the canopy down-wind to maximize ground speed. 62

Safety & Training Advisor (S&TA): A local person appointed by the Conference Director as his or her representative, who is available to provide advice and administrative assistance as the USPA representative at an individual drop zone. 11, 356

SCR: Star Crest Recipient. 360

SCS: Star Crest Soloist. 360

Seat belts: 42, 44

Single Operation System (SOS): Any system that combines a single point riser release and a reserve ripcord, so that pulling one handle will both release the risers and pull the reserve. 146, 159

Sink rate: 274

Skydiving: The freefall portion of a parachute jump. 8

S/L: Static line.

Sleeve: 257

Slider: A piece of fabric attached to the suspension lines of a ram-air canopy, which controls inflation by progressively sliding down the suspension lines during deployment. A reefing device. 57, 136, 242, 248, 258

Snivel: 136, 259

Smoke Jumping: 343

SOP: Standard Operating Procedure.

Span: The distance from wing tip to wing tip of a ram-air canopy. 269, 271

Speed, canopy: 193

Split saddle: The lower part of a harness which has independent leg straps, no saddle cross strap.

Sport parachutist: One who engages in parachuting as an avocation rather than as a vocation or duty. A skydiver.

Spot: The exit point. See Spotting.

Spotting: Selecting the course to fly, directing the pilot, and selecting the correct ground reference point over which to leave the aircraft, so that the jumper will have the best opportunity to land in the target area. 26, 44, 62, 219

Stable fall position: A position attained by the freefalling parachutist in which he makes only controlled, preplanned movements. Usually face to earth. See Chapter 5.

Stability: That property of a body which causes it, when its equilibrium is disturbed, to develop forces or movements tending to restore the original condition. In skydiving, having control of body position during freefall (not "Z" or unstable). 52, 53, 187

Stack: A vertical CRW formation with the jumpers gripping the canopy or lines at the canopy attachment. See Chapter 6.

Star Crest: 360

Static line (S/L): A line attached to the aircraft and to the parachute, which initiates deployment of the parachute as the load falls away from the aircraft. 40, 47, 52, 123, 129, 285, 312

Static line jump: A parachute jump during which deployment of the parachute is initiated by means of a static line attached to the aircraft, used primarily in student training and by military rapid deployment forces. 19, 52, 172

Statisitcs: 12, 110, 114

STC: Supplemental Type Certificate.

Stevens lanyard: Part of the Single Operation System (S.O.S). which activates the reserve when the main canopy is jettisoned. Named for the inventor, Perry Stevens. 308

Student: A parachutist trainee who has not qualified for a USPA Class A license.

Student in tow: 125

Suspension lines: Cords, usually nylon, Kevlar or Dacron, which connect the large cloth surface canopy to the risers. 272

"T" Type parachute: U.S. Army description for troop or training parachutes.

Tandem jump: A parachute jump with two people under the same canopy. 21, 105, 245

Target (disc, pea gravel, *peas*): The prepared landing area. In competition, a five cm. disc. 235

Technical Standard Order: U.S. Government regulations applying to standards of materials and products. Parachutes are covered by TSO-C23c. 246

Terminal velocity: The equilibrium speed at which a body falls through the air (14.7 psi) when resistance to the air (your size) equals the pull of gravity (your weight) to establish the approximate figure of 110 mph. (in the flat stable position); reached after the 9th second of freefall. 8, 178

3-Ring release: A riser release system consisting of three interlocking rings. 148, 287, 308

Throw-out pilot chute: A hand-deployed pilot chute system in which the skydiver grasps a springless pilot chute and vigorously throws it into the air stream. 129, 252, 312

Tracking: A position assumed by the freefalling parachutist in order to attain maximum horizontal movement. 196

Training Pilot Chute Toss: A practice ripcord pull with the Instructor Assisted Deployment system used for student training in Canada.

Tree landings: 154

Trim tabs: A locking front riser pulley system for adjusting a canopy's angle of attack or flight attitude.

TSO: Technical Standard Order. The FAA regulation that requires certain minimum performance standards and specifications for the certification of a parachute design. 246

Turbulence: 151

Turns: 198

United States Parachute Association (USPA): A voluntary membership association of skydivers, which is a non-profit division of the NAA, governing sport parachuting activities in the United States.

Waivers: Permission granted by a competent authority to deviate from the BSRs. Authority to grant waivers is vested in the Board of Directors, the Executive Committee, and in a few cases, the Safety & Training Advisor. 25, 67, 361

Water jump: A parachute jump which ends with an intentional landing in an open body of water. 155, 333

Weather: 152

Wind cone: 62, 65

Wind drift indicator (WDI): A device used to predict wind drift, so constructed as to descend at a rate comparable to a parachutist of average weight descending under a fully deployed main canopy of average specifications. Usually a weighted strip of crepe paper 10 inches wide and 20 feet long. 44, 223, 226

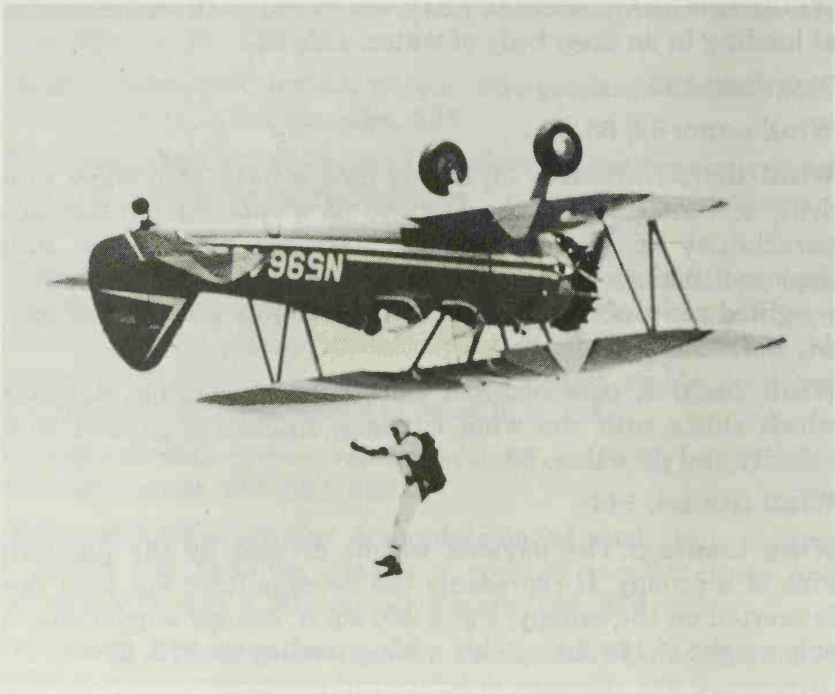
Wind sock: A pole-mounted cloth tube of varying diameter, which shifts with the wind changes, indicating ground wind velocity and direction. 59

Wind tunnel: 344

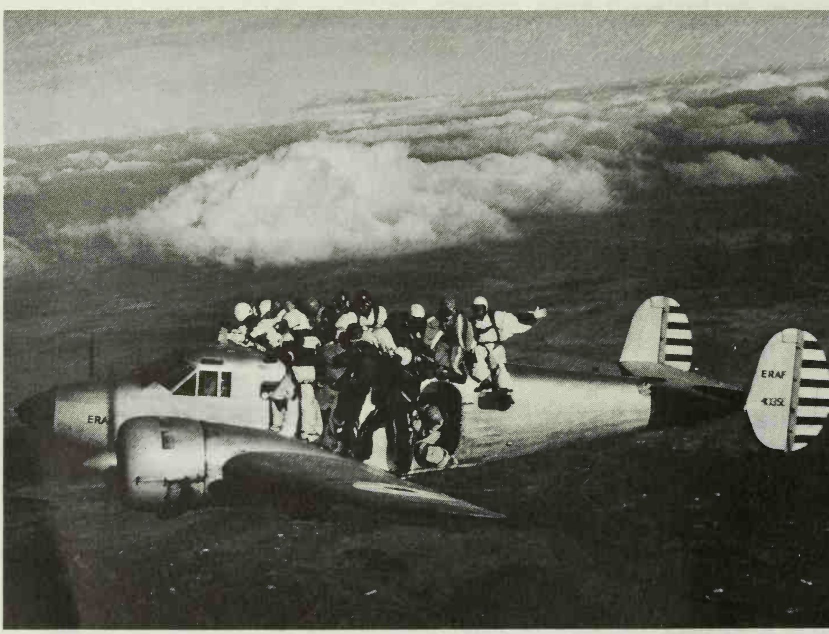
Wing loading: The payload weight divided by the planform area of a canopy. It represents the average force per area that is exerted on the canopy; e.g. a 200 sq. ft. canopy supporting an exit weight of 175 lbs., yields a wing loading of .875. 274

WHUFFO: A non-jumping spectator. Often heard to say: *Whuffo they jump out of airplanes?* A "ground hog."

WPC: World Parachuting Championship. 356

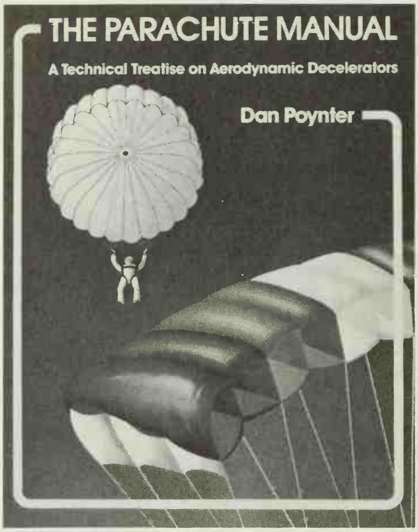


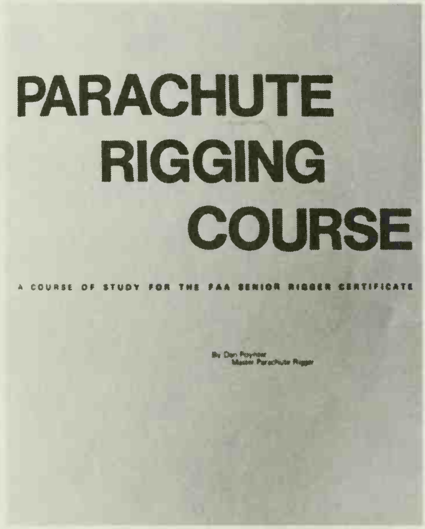
Bill Ottley drops out of a biplane



A no-frills flight *on* a Twin Beech

The pilot survived this ejection





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